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CONTENTS OF PREVIOUS NUMBERS

FEBRUARY, 1923. NUMBER 2

The Influence of Growth on the Basal Metabolism of Children. G. B. Fleming, M.D., Glasgow, Scotland.

Neuropsychiatric Sequelae of Acute Epidemic Encephalitis in Children. Franklin G. Ebaugh, M.D., Philadelphia.

Acute Hemorrhagic Encephalitis: Report of Case Following Scarlet Fever. John A. Toomey, M.D., Leon H. Dembo, M.D., and Guthrie McConnell, M.D., Cleveland.

Intraperitoneal Transfusion with Citrated Blood; An Experimental Study. David M. Siperstein, M.D., Minneapolis, and J. Martin Sansby, M.D., St. Paul.

Congenital Malaria: Report of a Case in Colorado. R. P. Forbes, M.D., Denver.

The Excretion of Foreign Protein in Human Milk. Harold C. Stuart, M.D., Boston.

Oxygen Therapy in Premature Babies with Anoxemia. Harry Bakwin, M.D., New York.

Toxemia of Severe Superficial Burns in Children. Bruce Robertson, M.B. (Tor.), and Gladys Boyd, M.B., Toronto, Canada.

Progress in Pediatrics:

A Review of the Literature on the Blood and Blood Diseases of Infants and Children for the Last Four Years (1918-1921). Louis Webb Hill, M.D., Boston.

MARCH, 1923. NUMBER 3

The Value of Basal Metabolism in the Diagnosis and Treatment of Cretinism. Fritz B. Talbot, M.D., and Margaret E. Moriarty, Boston.

The Bacteriology of the Urine in Acute Nephritis in Children. Lewis Webb Hill, M.D., Emily F. Hunt, A.M., and Elsie W. Brown, A.B., Boston.

Intraperitoneal Transfusion with Citrated Blood: A Clinical Study. David M. Siperstein, M.D., Minneapolis.

Polycystic Disease of the Kidneys. Report of Case in an Infant. Abraham Tow, M.D., New York.

Lead Poisoning in Infancy. L. Emmett Holt, Jr., M.D., Baltimore.

Types of Organism Found in a Series of Tuberculous Children. J. Keith Gordon, M.D., and Elsie W. Brown, B.Sc., Boston.

Calcium Absorption in Children on a Diet Low in Fat. L. Emmett Holt, M.D., and Helen L. Fales, New York.

APRIL, 1923. NUMBER 4

Brain Tumors in Young Children. A Clinical and Pathologic Study. Martha Wollstein, M.D., and Frederic H. Bartlett, M.D., New York.

The Characteristics of the Cerebrospinal Fluid in Postdiphtheric Paralysis. Joseph C. Regan, M.D.; Catherine Regan, M.D., and Brickhouse Wilson, M.D., Brooklyn.

Transfusion Through the Umbilical Vein in Hemorrhage of the New-Born: Report of a Case. J. Buren Sidbury, M.D., Wilmington, N. C.

The Causes of Absence in a Boys' School. C. H. Sanford, M.D., Concord, N. H.

The Saliva of the Nursling. A. Hymanson, M.D., New York, and Heinrich Davidsohn, M.D., Berlin.

A Bacteriologic Study of Acute Diarrheas in Young Children. Martha Wollstein, M.D., New York.

A Statistical Analysis of the Causes of Palpable Lymph Glands in the New-Born. Louis Dunn, M.D., and Halbert L. Dunn, M.D., Minneapolis.

Book Reviews.

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A CRITIQUE OF THE PIRQUET FEEDING SYSTEM *

WITH SPECIAL REFERENCE TO ITS UNDERLYING PRINCIPLES

HAROLD K. FABER, M.D.

SAN FRANCISCO

About four years ago, I summarized [1] Pirquet's interesting methods of feeding that had been developed and introduced in Vienna during the Great War. A considerable literature dealing with this subject has since then been produced, and several enthusiastic writers have advocated the adoption of these methods in this country. The general feeling here has apparently been that the methods, while interesting, were so revolutionary that their introduction would involve an endless confusion, to be avoided if possible. Few critical studies of the methods themselves have appeared, and almost none in this country. The visit of Pirquet to this country in 1921 was followed by a reawakening of interest in the subject which has culminated in the appearance of his own description of the system in book form in English,[2] based on the Silliman lectures at Yale. It would appear timely, therefore, to give critical consideration to the outstanding Pirquet innovations, which are of importance, if for no other reason, because of the wide publicity they have obtained.

ACCURACY OF MEASUREMENTS OF SITTING HEIGHT

Since, with the exception of the nem, all the Pirquet methods are directly based on the sitting height, it is essential to determine the practical limitations of accuracy in determining this body dimension. Pirquet, in his "System der Ernährung" [3] states that, with some practice, the error of measurement is not in excess of 1 cm. This in itself is by no means negligible, since such an error will alter the pelidisi by nearly two points, and throw a child out of or into the group regarded

* Received for publication, March 26, 1923.

* From the Division of Pediatrics, Stanford University Medical School.

1. Faber, H. K.: Von Pirquet's Feeding System, Am. J. Dis. Child. **19**:478 (June) 1920.

2. Pirquet, Clemens: An Outline of the Pirquet System of Nutrition, Philadelphia, W. B. Saunders Company, 1922.

3. Pirquet, Clemens: System der Ernährung, Berlin, Julius Springer, 1917.

as pathologically malnourished. It should be recalled that such a difference corresponds to from 5 to 10 per cent. of the body weight. Thus, a child only 5 per cent. underweight might, according to the direction of the error, be regarded as either 10 per cent. underweight or normal. Checked by the stem length in the series of sixty-five children, errors of 5 cm. in measuring sitting height were found, and Gray [4] has recently reported the same discrepancies. Essentially, these discrepancies are due, as Gray points out, to the fact that, in measuring sitting height, the child sits on the posterior muscles of the thighs, which may be contracted, increasing the sitting height; or relaxed, reducing it. An error of 5 cm. may alter the pelidisi index by 8 to 10 points, and the percentage index by 20 per cent. to nearly 50 per cent. In a 60 cm. child, it will alter the siqua by nearly 18 per cent., and the body surface, as calculated from the sitting height, nearly 19 per cent. The sitting height, therefore, is a dangerously inaccurate measure. It can be easily supplanted by the stem length of Dreyer, which appears to have many advantages of accuracy.

PELIDISI—THE PIRQUET INDEX OF NUTRITION

Estimates of the value of the pelidisi nutritional index based on clinical impressions vary so greatly that a final opinion cannot fairly be formed from a study of the literature; nor can a definite opinion as to its merits as compared with other indexes be formed on the basis of clinical data at present available. I have already shown [5] its serious lack of correspondence with the "percentage of normal weight" index commonly used in this country. Without attempting to add at present to the clinical impressions one obtains from the use of the Pirquet index, one may consider its basic structure, with a view to understanding its possibilities and limitations.

Pelidisi is the cube root of 10 times the body weight (in grams) divided by the sitting height in centimeters and multiplied by 100. Thus, an increase in weight (improved nutrition) is reflected by an increase in the nutrional index by the cube root of the gain, not by a direct proportion, as when percentage of normal weight is used. Growth in body length, on the other hand, is reflected in the index by direct proportion.

The normal or average pelidisi during most of childhood is about 94, as shown by Pirquet, Gray [6] and others, and not 100. Through the

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4. Gray, H.: Sitting Height and Stem Length in Private School Boys, Am. J. Dis. Child. **23**:406 (May) 1922.

5. Faber, H. K.: The Pirquet System of Nutrition and Its Applicability to American Conditions, J. A. M. A. **77**:1837 (Dec. 3) 1921.

6. Gray, H., and Edmands, G. H.: Indices of the State of Nutrition in Children, Am. J. Dis. Child. **23**:226 (March) 1922.

introduction of the factor 10 in the formula (equivalent to multiplication of the quotient by 2.15+), an intentional but nevertheless unfortunate resemblance to a percentage scale has been created which is very misleading. To understand the actual significance of pelidisi in terms of its apparent congener, the percentage of normal weight, a rather elaborate calculation is necessary. In Table 1, a comparison of the two scales has been made. The weight corresponding with a pelidisi of the normal 94 at a given sitting height was divided by weights corresponding with other values of the pelidisi for the same sitting height. This gives the percentages of normal weight corresponding with the various values of the pelidisi.

TABLE 1.—*Relation Between Pelidisi and Percentage Under and Over Weight Ninety-Four Pelidisi Taken as Normal*

Pelidisi	Percentage of Normal Weight	Percentage Over or Under Weight	Difference Corresponding With One Point Pelidisi, per Cent.
80	61.6	—38.4	2.4
82	66.4	—33.6	2.5
84	71.4	—28.6	2.6
86	76.6	—23.4	2.7
88	82.0	—18.0	2.9
90	87.8	—12.2	3.0
92	93.8	— 6.2	3.1
94	100	0	3.3
96	106.5	+ 6.5	3.4
98	113.3	+13.3	3.5
100	120.4	+20.4	3.7
102	127.8	+27.8	3.8
104	135.4	+35.4	4.0
106	143.4	+43.4	4.1
108	151.7	+51.7	4.3
110	160.2	+60.2	4.5
112	169.2	+69.2	4.6
114	178.4	+78.4	4.8
116	187.9	+87.9	4.9

From a study of the table, it is at once apparent why, in certain studies, so small a percentage of children attained the apparently normal 100, since this value actually corresponds to 20.4 per cent. overweight, and why so large a percentage of children in one community which had reason to regard the average nutritional status of its children as good should have fallen into the Viennese category of "mild

malnutrition,"[7] since, in any series of normal cases, approximately one half will fall below and one half rise above the average normal, in this case a pelidisi of 94, corresponding to 100 per cent.

Another important point to be noted in the table is that pelidisi cannot be readily—certainly, not mentally—translated into terms of percentage of normal weight. This is important because the latter is the common-sense interpretation of a nutritional index, its obvious and accepted meaning. It is clear, indeed, that Pirquet in devising his index used ten times the weight to simulate a percentage value with this idea in mind, and it has mislead many, if not most, of his followers.

Another important objection to the Pirquet index is the undue error introduced in it by relatively slight and common errors in measuring the sitting height, and the comparatively small effect made on it either by errors in weighing or by actual gains or losses in weight of considerable magnitude. Thus, an error of 1 cm. in measuring a 25 kg. child with a sitting height of 63 cm. will alter the pelidisi by 1.6 points, or about 6 per cent. in normal weight, a discrepancy greater than that caused by a difference of 1 kg. (2.2 pounds) in weight.

When the difficulties of measuring sitting height with even approximate accuracy are considered, it would seem unwise to accept for practical use a nutritional index with the inherent disadvantages named.

RELATION BETWEEN SITTING HEIGHT AND INTESTINAL AREA

Pirquet has laid great stress on the fundamental nature of his claimed direct relation between the square of the sitting height and the intestinal area. In his earlier publication, it is assumed to have the force of a natural law. The data on which he bases his claim are, however, very unconvincing, since they are derived from *averages* of sitting height and the mean of two rough estimates by Sappey of the area of the distended and undistended *small* intestine. Presenting no data at all as to individual variations of intestinal area, and no measurements of intestinal area and sitting height in the same individual, Pirquet's theory can scarcely be regarded as having any scientific validity; certainly nothing more than an indication of a possible general trend. Further, it is freely admitted by the author that because of villi, valvulae conniventes and other irregularities of the intestinal wall, it is practically impossible to determine the actual area of the intestinal epithelium. Indeed, in his last book he proclaims the relationship, formerly described as a natural law, as a "symbol," asking the reader to accept it as a matter of course. It is difficult for one who is only

7. Carter, W. E.: The Pirquet System of Nutrition and Its Applicability to American Conditions, J. A. M. A. **77**:1541 (Nov. 12) 1921.

moderately critical to agree even to this extent. The evidence at hand justifies the conclusion that the existence of such a relationship is unproved and probably unprovable.

RELATION BETWEEN INTESTINAL AREA AND FOOD REQUIREMENTS

That there is a direct relationship between intestinal area and food requirements is an important part of Pirquet's theory. The considerations of the preceding paragraph show that the former cannot be measured. Pirquet rests his argument on the pure assumption that the food requirements of the individual must correspond with the area from which food can be absorbed and not essentially with the amount of heat produced by the body from the food ingested. Such a theory of metabolism disregards certain well established facts:

1. All healthy organs possess a functional reserve, having more tissue or capacity of function than is called into use under ordinary conditions; and the amount of such reserve cannot be assumed *a priori*.

2. Different parts of the intestine have different rates of absorption and qualitative differences in the food materials absorbed.

3. The body may absorb more food than it actually requires, and either store or excrete the excess.

4. The heat output, together with the determination of retention and loss by excretion, has been convincingly shown by many metabolic experiments to be the true measure of the useful employment of food by the body, and hence of the food requirements.

The critical reader who is willing to be convinced must, without further proof, reject this part of Pirquet's theory.

RELATION BETWEEN SITTING HEIGHT, AND FOOD REQUIREMENTS AND BODY SURFACE

On the assumption that the sitting height squared is equal to the area of the intestine and that the latter stands in direct ratio to the individual's needs of food, Pirquet has provided a series of formulas for estimating food requirements from the sitting height which have apparently put to practical test the validity of his theories. There can be little doubt, since the Pirquet feeding method has been used on a tremendous scale over a considerable period of time, that it does give an approximate measure of the individual food requirements. Apart from the question as to whether this actually substantiates the Pirquet theories, it is a question of some importance whether the Pirquet method is a better one than those more commonly used, which are based on body weight, or body surface when accuracy is essential. As is well known, Rubner's theory that basal metabolism stands in relationship to

body surface is based on experimental and clinical data, today widely accepted. Its validity has been recently reaffirmed in an emphatic manner by Lusk,[8] on the basis of careful test and check; and the findings of Benedict and Talbot,[9] though they establish a considerable normal variability, in general agree. Finally, the widespread clinical use of apparatus for measuring basal metabolism has given much further confirmation.[10] The average heat output during conditions of minimum normal (basal) metabolism, after infancy, is, roughly, 1,000 calories per square meter of body surface, or 0.1 calory per square centimeter. To this must be added certain quotas, conveniently expressed in percentages of the basal needs if desired, for growth, excretory waste, muscular activity, "cost of digestion" and so on.

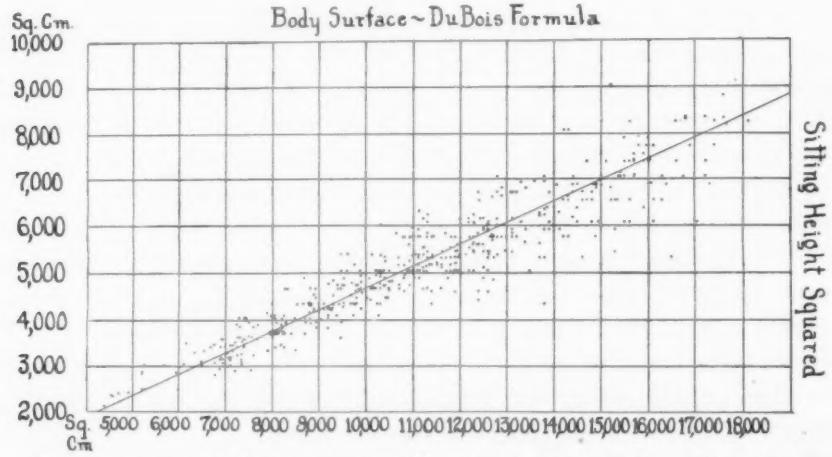

Chart 1.—Sitting height squared (Si^2) plotted against body surface (A) by the Du Bois formula, $A = W.^{425} \times H.^{725} \times 71.84$. The diagonal line represents $Si^2 \times 2.1 = A$ (500 cases).

Pirquet's formula for estimating basal food requirements, which corresponds with the needs for basal metabolism, is:

Three tenths nem $\times$ Si^2, when Si is the sitting height in centimeters. Since 1 nem equals two thirds of a calory, the formula can be expressed as:

$$\cdot 0.2 \text{ calory} \times Si^2.$$

If we wish to compare the Rubner formula with the Pirquet, it is necessary to determine the relationship between the square of the

8. Lusk, Graham: Fundamental Ideas Regarding Basal Metabolism, J. A. M. A. **77**:250 (July 23) 1921.

9. Benedict, F. G., and Talbot, F. B.: Metabolism and Growth from Birth to Puberty, Carnegie Inst. Washington Pub., No. 302, 1921.

10. Progress of Clinical Calorimetry in the United States, editorial, J. A. M. A. **80**:184 (Jan. 20) 1923.

sitting height and the body surface. The latter is now generally obtained with approximate accuracy from the Du Bois formula

$$A = H.^{.725} \times W.^{.425} \times 71.84$$

conveniently applied by means of the special chart of Du Bois or that of Boothby.

Five hundred boys between the ages of 2 and 15 years were measured for height, weight and sitting height. Weight was taken in indoor clothing, with coats and shoes removed. The body surface was found by using the Boothby chart, and plotted against the sitting height squared, with the result shown in Chart 1.

It was found that the ratio of average sitting height squared to average body surface was about 1 : 2, or more exactly

$$A = 2.14 + \times Si^2$$

$$\text{or, } Si^2 = \frac{A}{2.14}$$

when A equals body surface in square centimeters.

This formula makes it possible to compare the Rubner and the Pirquet formulas. By interpolation

$$0.2 \text{ calories} \times Si^2 \text{ becomes}$$
$$0.2 \text{ calories} \times \frac{A}{2.14}, \text{ or } 0.093 \text{ calories} \times A.$$

Thus the basal requirements are 0.093 calories per square centimeter, or 930 per square meter.

It is therefore clear that the Pirquet formula for basal food requirements corresponds closely with Rubner's estimate, the former calling for about 930 calories per square meter and the latter for about 1,000.

Chart 1 shows clearly that there is a general trend toward correspondence between sitting height squared and body surface. For the lower values of both, the correlation is very close, but the "scatter" becomes much more marked for the larger values. Assuming, as I think we are justified in doing, that the Du Bois formula is reasonably accurate (probably the error is not more than 5 per cent.), the sitting height is a fairly accurate measure of the body surface in about 75 per cent. of cases, and it is an approximate measure of it in about 90 per cent. To this fact it seems reasonable to attribute such success as the Pirquet method has had in indicating food requirements.

It would be interesting to know whether a more accurate measure of trunk and head length would show a closer correspondence of values. The stem length, now generally preferred by anthropologists to the sitting height because it measures the distance between the bony points, and is not affected by contraction or relaxation of the posterior thigh mucles as is the sitting height, should be considered for this purpose.

A series of sixty-five children between the ages of 3 and 18 years were very carefully measured, undressed. The stem length, sitting height and weight were taken. Body surface was calculated directly from the Du Bois formula, not from the chart. The stem lengths squared were plotted against body surface, as shown in Chart 2.

Discrepancies between stem length and sitting height were found to range from 0 to 5 cm. The average prediction error of body surface calculated from the formula $A = St^2 \times 2.1$ (represented by the solid diagonal line in the figure) was $\pm$ 3.06 per cent., and the maximum error was 9.2 per cent. This degree of correlation is obviously much greater (though in a smaller series) than was found for sitting height squared in the first series, a fact readily explainable on the inherent inaccuracy of sitting height measurements.

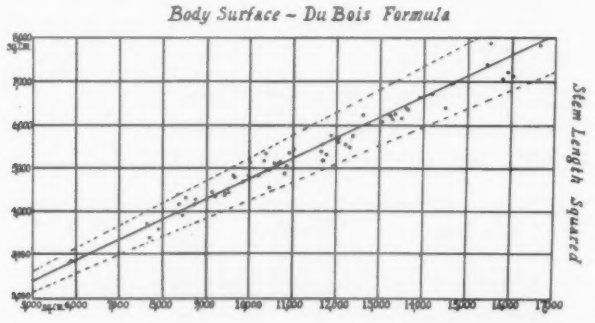

Chart 2.—Stem length squared (St^2) plotted against body surface (A). The solid diagonal represents $St^2 \times 2.1 = A$. The dotted lines denote a 5 per cent. variation (sixty-five cases).

It would appear, then, that body surface can be estimated during childhood with a certain degree of accuracy from the stem length, by a simple formula which can be applied without special chart, slide rule or logarithms, involving two simple multiplications only: $St \times St \times 2.1$

The usefulness of this formula is limited, since it must apply only to individuals of approximately normal conformation. Weight has a distinct influence on surface, and it is not considered in the foregoing formula. Morever, the factor 2.1 is not quite correct for the smallest or largest children; in the former, it is about 2.05; in the latter, about 2.2, and for adults it may well be about 2.3 or 2.4.

THE NEM

Pirquet's original reason for proposing a new unit of food value in place of the calory was a desire to increase popular understanding and use of the scientific measurement of food, in the hope that food, during

the period of war scarcity, might be conserved. He believed that it would be impossible to popularize the calory not only because both the laity and medical profession were largely unfamiliar with the term and its meaning, but also because it was based on a conception of combustion which would never appeal to the popular imagination. If all foods could be compared with milk, on the other hand, the great advantage of visualization would be secured. Scientific accuracy would be secured by adopting as a standard a milk of certain composition having a value of 667 calories per liter. To a liter of such milk, the value of 1,000 nem (1 nem per cubic centimeter) was assigned. From the rather ingenious appeal of this conception, Pirquet has detracted, it seems to me, by his later argument that food should be considered in the light of units of intake, of assimilable energy, rather than as units of heat. The inference of his latest publication in English, that the calory implies the total combustible value of food rather than the energy available to the body from it, is, of course, quite untrue, unless considered as mere hair-splitting. Atwater and Kent [11] state that "by fuel value is meant the number of calories of heat equivalent to the energy which it is assumed the body would be able to obtain from a pound of a given material, provided the nutrients of the latter were completely digested." A direct comparison of Pirquet's nem values for food with Atwater and Kent's caloric values makes it clear that the former are merely converted from caloric values and not obtained by a new method. The essential meaning of the two terms is therefore identical, and the difference between them is merely arithmetical. One calory equals one and one-half nems. One nem equals two thirds of a calory.

It is true of the laity and medical profession in this country that the calory is generally understood and commonly used in practice. Physicians, nurses and dietitians constantly think of diet in terms of calories, and the same may be said of the thousands of lay people who are ridding themselves of superfluous flesh by "counting their calories."

So distasteful is the prospect of substituting a new unit of any kind for one already established that the change could be brought about only by overwhelming advantages to be gained. That such advantages are to be had from adoption of the Pirquet food unit, at least in this country, I see no reason to believe. That the nem will ever be generally adopted here is highly improbable, but efforts to have it adopted, while doomed to failure, are certain to lead to confusion, both within and without the profession. Finally, if one wishes, he can visualize fuel values of foods as ounces of milk by dividing the calories by 20.

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11. Atwater and Kent: The Chemical Composition of American Food Materials, p. 14.

CORRELATIONS OF HEIGHT, SITTING HEIGHT AND WEIGHT

As an appendix to the discussion of methods based on sitting height, Table 2 presents coefficients of correlation and correlation ratios.[12] The data from which they have been computed consist of measurements of the 500 boys already mentioned.

The figures show clearly that height is more closely correlated with weight and with the cube root of weight than is sitting height. The one advantage shown by sitting height (confirming Pirquet) is that its general relation to the cube root of weight is linear, while that of height is curvilinear. In other words, sitting height shows rather roughly a simple arithmetical relation to the cube root of weight, independently of size (and hence, of age), which is not true of standing height. Quite outbalancing this advantage is the superior reliability of the relation of height both to weight and to the cube root of weight. The very practical inference is to be made that height-weight standards of

TABLE 2.—*Coefficient of Correlation and Correlation Ratios*

	Coefficient of Correlation (r)	Correlation Ratio (η)	Blakeman's Criterion
Height-Weight.....	0.898 ± 0.006	0.964	5.88
Sitting Height-Weight.....	0.857 ± 0.008	0.900	6.77
Height-$\sqrt[3]{}$ Weight.....	0.903 ± 0.006	0.994	6.91
Sitting Height-$\sqrt[3]{}$ Weight....	0.882 ± 0.007	0.876	0
Sitting Height-Height.....	0.921 ± 0.005	0.934	2.97

nutrition are more reliable than sitting height standards. The same may not be true of stem length, but certainly we are not yet in a position to adopt this measure as a standard. For the present at least, every consideration favors the continuance with such modifications as shall be shown necessary of the height-weight standards now in general use in this country.

SUMMARY AND CONCLUSIONS

Practical and theoretical reasons both militate against the general adoption of the Pirquet system of feeding. The sitting height on which it is based cannot be measured with sufficient accuracy, and even slight errors in this measurement lead to serious errors in calculating

12. The coefficient of correlation (r) and the correlation ratio (η) both show, on a scale of 0 to 1.0, the degree of relationship between two variables, such as height and weight. If, when these variables are plotted against each other on ordinate paper, the general trend is about a straight line, both the coefficient of correlation and the correlation ratio express the relationship. If the general trend is about a curved line, the correlation ratio (η) alone expresses it. Hence, if ratio and coefficient are quite similar, the trend is along a straight line. If separated, the trend is along a curved line. Blakeman's criterion, expressing the difference between ratio and coeffiicient, must be 2.5 or less, if the distribution is to be regarded as linear.

the nutritional status of the individual and his food requirements. The Pirquet index of nutrition has a misleading resemblance to a percentage of normal weight, into which it cannot readily be translated. The Pirquet theory that sitting height and intestinal area are in close correspondence is neither susceptible of proof nor consonant with probability. Its corollary, that sitting height and food requirements bear a relationship to each other, while based on false premises, is probably true, but depends for its validity on the fact that sitting height and body surface show a certain degree of correlation. This correlation is not close enough to permit the accurate calculation of body surface from sitting height. Finally, the introduction of Pirquet's food unit, the nem, to supplant the calory is highly undesirable, largely for practical reasons, and presents no advantages that would appeal to the American public.

MONGOLISM IN ONE OF TWINS AND THE ETIOLOGY OF MONGOLISM *

T. HALBERTSMA, M.D.
HAARLEM, HOLLAND

That the occurrence of mongolism in twins must be regarded as important and that it may possibly throw light on the etiology are admitted by all authors that have studied this affection. Since the publication of Fraser's [1] paper, ten cases of mongolism in one of twins and two cases in both have been reported. I have been able to add to this series five new cases in which only one of the twins was a mongolian idiot.

A study of the literature reveals that almost nothing is known about the causation of mongolism. Several authors have regarded the affection as dependent upon diseases of the mother, or as acquired during pregnancy through the operation of other influences injurious to the embryo. The only fact that can be asserted as having etiologic significance is that the great majority of mongolians are the children of mothers who are nearing the end of the child-bearing period. For this reason these children are often the last of large families. Other congenital abnormalities are often encountered.

Shuttleworth [2] has spoken of mongolians as "exhaustion products"; but it seems to me that this term is only another expression of the etiologic factor of old mothers. Thomson [3] says that it seems that something goes wrong in very early uterine life—probably by the second month, judging from the nature of the cardiac defects.

Van der Scheer [4] has spoken of mongolism as belonging to that type of malformation in which there is a central defect of the head, such as cyclopia, cebocephalia and arhinencephalia. McLean [5] described recently a mongoloid appearance in one of twins. He said that if the condition of the mother during pregnancy were related to the etiology one should always expect that the identical pathologic condition would be present in both twins.

I have come to the same conclusion, and I will endeavor to show in this paper that mongolian idiocy is of germinal origin, and that the

* Received for publication, Jan. 31, 1923.

1. Fraser and Mitchell: J. Ment. Sc., 1877.
2. Shuttleworth, G. E.: Brit. M. J. **2**:661, 1909.
3. Thomson in Garrod, A. E.; Batten, F. E., and Thursfield, Hugh: Diseases of Children, New York, Longmans Green & Co., 1913.
4. Van der Scheer: Psychiat. en Neurol. Bl., 1918.
5. McLean, Stafford: Mongolian Idiocy in One of Twins, J. A. M. A. **78**: 13 (Jan. 7) 1922.

theories that accept the possibility of an acquired origin during intrauterine life are untenable.[6]

REPORT OF CASES

CASE 1.—Baby L., aged 10 months, was one of twin boys born when the mother was 38. Their birth marked the sixth pregnancy. The patient was a typical mongol; the other child was normal in every respect. Measurements of the head of the mongol were: greatest length, 12.5 cm., greatest breadth, 12.5 cm., horizontal circumference, 40.5 cm. The mongol's weight was 3,700 kg. He could not sit unsupported, did not speak and had no teeth as yet. The Wassermann reaction was negative. At the birth of the twins two placentas were seen, and each child had its own chorion and amnion.

CASE 2.—Baby v. L., aged 4½ months, was one of twin girls. The mother was 41 at the time of their birth. This marked the fourteenth pregnancy; there had been three miscarriages. There were two well separated placentas, with two chorions and amnions. The Wassermann reaction was negative. The measurements of the head of each twin immediately after birth (measurement of mongolian mentioned first) were: greatest length, 46 and 48 cm.; greatest breadth, 9 and 9.5 cm.; horizontal circumference, 30 and 33 cm.; weight, 2,600 and 2,800 kg. The mongolian was typical. She showed as an accompanying deformity a preauricular appendage on the right, and was in such bad condition that she soon died of bronchopneumonia. The twin sister is normal.

CASE 3.—Baby R., aged 2½ years, boy, a mongolian idiot was one of twins, the sister being normal. The mother was 43 when the children were born. Their birth marked the seventh pregnancy. The mongol was clubfooted on both sides; the girl was absolutely normal.

CASE 4.—Baby v. B., aged 2½ years, boy, a mongolian idiot, was one of twins, the girl being normal. The mother was 38 at the time of their birth; the father was 48 years of age. The mongolian was typical; the girl showed no abnormalities.

CASE 5.—Baby J. L., aged 4 years, boy, twin, presented a typical mongolian appearance. The mother was 44 years of age when the mongol was born (ninth pregnancy). At the end of the third month of pregnancy there was a miscarriage; six months afterward, the mongol was born at term. The idiot child sat unsupported at 1½ years, dentation began at 3 years. The child now has a pigeon-breast.

COMMENT

It is evident that all of these cases of mongolian idiocy resulted from a so-called two-egg pregnancy. As is known, twins are of two types. The one-egg, or identical, twins are derived from a single egg, which has formed two embryos. They are always of the same sex, are enveloped in the same chorion, and there is only one placenta. The children show marked resemblance. As the entire heritable nature is common to both, germinal affections will be equally present in both. I refer to twins with epilepsy and asthma. Acquired diseases of which the cause may be sought in the condition, such as syphilis, of the mother during pregnancy will also manifest themselves in both. In the two-egg, or fraternal, twins, there have been two eggs which were fertil-

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6. Cases 1 and 2 were observed at the Leiden Pediatric Clinic by the author. For the data concerning Cases, 3, 4 and 5, the author is indebted to Dr. W. M. van der Scheer, Inspector of Lunatic Asylums in Holland.

ized separately. Each embryo is enveloped in its own chorion, and they are no more closely related than ordinary brothers and sisters; their sex may be different or the same. One of them may be affected by an inheritable disease (achondroplasia), while the other is absolutely normal. Diseases of the mother that might affect the embryo (syphilis) will generally manifest themselves in both twins, although the symptoms may vary.

We may now return to our problem, and ask whether mongolism is germinal in origin or acquired. If mongolism were not germinal in origin but acquired, then the occurrence of mongolism in one of twins would be a surprise. A review of the literature revealed fifteen such

TABLE 1.—CASES OF MONGOLISM IN ONE OF TWINS

No.	Author	Sex of Twins	Type of Twin-Birth
1	Fraser (J. Ment. Sc., 1877)	"The mongol was one of twins"	Unknown
2	Hultgren (Nord. med. Ark., 1915)	Mongol boy; normal girl	Two-egg
3	Neumann (Berl. klin. Wchnschr., 1899)	Mongol boy; normal girl	Two-egg
4	Cassel (Berl. klin. Wchnschr. **54**: 159, 1917)	Mongol boy; normal girl	Two-egg
5	Cassel (ibid.)	Mongol girl; normal boy	Two-egg
6	Shuttleworth (Brit. M. J. **2**:661, 1909)	Mongol girl; normal boy	Two-egg
7	Comby (Arch. de méd. d. en. **20**: 505 [Oct.] 1917; cont. **20**:561 [Nov.] 1917; cont. **20**:617 [Dec.] 1917)	Mongol girl; normal boy	Two-egg
8	Weigall (quoted by Comby)	? ?	Unknown
9	Swanberg-Haynes (Arch. Neurol. & Psychiat. **1**:717 [June] 1919)	Mongol boy; normal girl	Two-egg
10	McLean (J. A. M. A. **78**:13 [Jan. 7] 1922)	Mongol boy; normal girl	Two-egg
11	Halbertsma	Mongol boy; normal boy	Two-egg
12	Halbertsma	Mongol girl; normal girl	Two-egg
13	Halbertsma	Mongol boy; normal girl	Two-egg
14	Halbertsma	Mongol boy; normal girl	Two-egg
15	Halbertsma	Mongol boy ?	Two-egg

cases, and only two cases of mongolism in both twins. It would be difficult to imagine how one child could remain absolutely normal, while the other showed the numerous and universal symptoms of mongolism.

If, however, mongolism is due to defects inherent in the germ plasm, then the occurrence of mongolism in one of the twins is comprehensible; but it will only be possible in a two-egg pregnancy. The hypothesis would be untenable if one could show twins resulting from a one-egg pregnancy of whom one was a mongol and the other was normal. It will be difficult in a case of mongolism in twins to determine whether the condition resulted from a one-egg or two-egg preg-

nancy unless the sex is different, or unless one can secure information about the fetal membranes and the placenta—as was possible in my cases.

An examination of the cases from the literature revealed that, in accordance with the theory, in all cases of mongolism in one of twins, the two-egg pregnancy was evident, for in all cases the sex was different (no data about two cases).

TABLE 2.—Cases of Mongolism in Both Twins

No.	Author	Sex of Twins	Type of Twin-birth
1	Hjorth (quoted by Shuttleworth, Footnote 2)	Same sex	One-egg (?)
2	de Bruin (Nederlandsch. Tijdschr. v. Geneesk, 1902)	Two mongol boys	One-egg (?)

If we now consider the cases of mongolism in both twins, the germinal theory makes the birth of these twins possible only in case of one-egg pregnancy. Although a two-egg pregnancy in these cases is imaginable, as the result of the coincidence of two separate eggs both doomed to mongolism, this will occur very seldom, as mongolism in more than one child of the same mother is almost never reported. In this connection, it was interesting that in the only two cases reported the twins were of the same sex. Cases of twin mongols of different sex do not exist.

SUMMARY

The conclusion that mongolism is germinal in origin is deduced from the fact that mongolism occurs in one of twins. An examination of these cases reveals that all have resulted from a two-egg pregnancy. Cases of mongolism in both twins of different sex are unknown; of like sex, there are cases described, which is in accordance with the theory that mongolism has to be regarded as the result of defects inherent in the germ plasm.

ULCERATIVE STOMATITIS AND ITS TREATMENT BY THE INTRAVENOUS INJECTION OF ARSENIC*

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Those who were in the service during the recent war and particularly those who served in any one of the fields of battle will recall the disease which was more or less prevalent among the rank and file and which was popularly known as trench mouth. The condition was not serious in that it did not impair the man's fighting efficiency, but it was annoying because of its contagiousness and its resistance to treatment. The frequency with which this condition has been encountered during the last two years among the children of this city has excited no little comment. It is designated by several names: suppurative gingivitis, Vincent's angina, trench mouth and ulcerative stomatitis. The latter term has been used, however, to describe two conditions which, I believe, are not identical either etiologically or clinically, but which frequently coexist in the same patient.

The terms Vincent's angina, trench mouth and suppurative gingivitis refer to an acute infection of the gums by spirilla and fusiform bacilli, producing certain local signs, such as spongy, bleeding gums, necrotic areas in the immediate vicinity of the teeth and general symptoms, such as malaise, pyrexia and anorexia. The term ulcerative stomatitis, although used to describe a similar condition, is also used to describe the disease characterized by the formation of small ulcers on the tongue or buccal mucous membrane without involvement of the gums. These ulcers are usually superficial and covered by a grayish exudate but lack the ragged necrotic appearance which characterizes the ulceration of the gums referred to above. Although this variety of stomatitis is frequently seen in combination with Vincent's infection of the gums it is, in all probability, not one and the same infective process.

ETIOLOGIC FACTORS

The predisposing causes of suppurative gingivitis are lowered vitality and oral uncleanliness. Such a lowering of vitality is liable to occur after any one of the infectious diseases or even following an acute upper respiratory infection. Several writers have emphasized its increased frequency during the cold months, though the reason for this

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* From the wards and outpatient department of the Hospital for Sick Children.

is not very obvious. The exciting cause is an infection of the gums by Vincent's organisms. Smears from the purulent material which exudes from the margin of the gums show large numbers of spirilla and fusiform bacilli, some necrotic material and a striking paucity of polymorphonuclear leukocytes.

Convincing experimental proof has been advanced to show that the spirillum and fusiform bacillus are actually pleomorphic forms of the same organism.

The importance of oral uncleanliness as a predisposing cause has been satisfactorily demonstrated by a comparative bacteriologic study of the mouths of persons with normal and with decayed teeth. Smears from the buccal mucous membrane of fifty normal mouths gave only one positive result for Vincent's organisms. Smears from the teeth of twenty-five normal persons gave four positive results, whereas smears from diseased teeth of a large number of persons gave 90 per cent. positive results.[1] It requires, therefore, no stretch of the imagination to picture these organisms lurking in carious teeth waiting for the lowering of the body resistance which will enable them to invade and infect the gums.

EPIDEMIOLOGY

Although the infection is, in many cases, autogenic, it is very readily transmitted from one person to another. It is not uncommon to find several cases in one household or in one school or even along one street. In the series of cases reported in this article, five occurred in separate houses in one locality, and the infection was traced to a boy 12 years of age. The two principal modes of transmission are kissing and the use of food utensils which have been carelessly washed. All persons with dental caries must be considered carriers of the disease in view of the bacteriologic findings enumerated above. On several occasions during the last year, the only source of infection which could be discovered was the presence of carious teeth in either parent, and in one case in private practice smears taken from the mother's teeth revealed large numbers of spirilla and fusiform bacilli.

SYMPTOMATOLOGY

The onset of the condition is usually sudden. Undernourished children are more frequently attacked, or children that are debilitated as the result of some acute infective fever. There is a general malaise and a slight elevation of temperature seldom above 101 F.

Anorexia is an early and constant symptom, the child refusing all solid food; even liquids are taken sparingly. The breath is very offen-

1. Reckord, F. F. D., and Baker, M. C.: Vincent's Angina Infection: Its Prevalence, Manifestations, Bacteriology and Treatment, J. A. M. A. **75**:1620 (Dec. 11) 1920.

sive, the odor being identical with that given off from any putrefactive process. The gums are deep red or purplish and heaped up around the teeth; they bleed very readily at the slightest touch, and, if the disease has been of four or five days' standing, there are often areas of necrosis along the gum margin. At times similar areas of necrosis are seen under the tongue, on the buccal mucous membrane or even in the faucial region. Pressure on the gums may cause blood-stained pus to exude along the free margin. The diseased parts are painful and tender to the touch, and the child resents vigorously any attempt at examination. If untreated or improperly treated, the process extends into the alveolar sockets, resulting in the loosening and falling out of the teeth. As a rule, the lymphatic glands below the jaw are enlarged and tender, but actual necrosis of the glands is rare.

TREATMENT

Prior to the recognition of this disease as a spirillum infection, the treatment consisted of the local and internal administration of potassium chlorate. During recent years, however, the employment of some form of arsenic in solution has been advocated, the most popular formula being known as Bowman's solution, which consists of solution of potassium arsenite, 12 c.c.; wine of ipecac, 12 c.c., and glycerin, 8 c.c. This was painted on the inflamed gums several times daily, but although the relief was immediate it was not always permanent. In other words, local arsenical applications did not appear to reach the deeper foci of infection, and the process tended to recur as soon as treatment lapsed. It seemed reasonable to assume that arsenic administered intravenously would be more apt to reach these deep foci and thus effect a more lasting cure.

Twenty-five cases have been treated in this manner in the last eleven months, and the results of treatment have been always satisfactory, and at times spectacular. All of the children were more than 1 year of age and 87.5 per cent. were more than 2 years. There were no instances of the disease occurring in children before the eruption of teeth.

In eight cases Bowman's solution was used locally in conjunction with an intravenous injection of an arsenical salt such as neoarsphenamin. Improvement was marked in from two to four days, and cure was effected in an average of five and three-fourths days.

In seventeen cases no treatment was used other than the intravenous injection. One of these children was suffering, at the time of injection, from an acute intestinal intoxication, and died a few hours afterward. Among the others improvement was noted on an average two and one-half days after injection, and complete cure was recorded on an average of five and three-eighths days. In two cases, eleven and thirteen days, respectively, elapsed before recovery was complete, and

both these children required two intravenous treatments. One child that had been treated for eighteen days with local applications of Bowman's solution without visible improvement was completely cured eight days after intravenous medication was given. A short summary of one of the most severe cases is worth recording.

REPORT OF CASE

A boy, aged 12, was admitted to the surgical ward of the Hospital for Sick Children with a history of swelling of the lower jaw of three days' duration and of a sore mouth for five days. Examination revealed a probable osteomyelitis of the inferior mandible. An operation was performed and a quantity of foul smelling pus was evacuated through an incision in the left submaxillary region. It was difficult to obtain a satisfactory view of the teeth and gums since the child could not open his mouth without considerable pain; but the gums about the upper and lower incisors and bicuspids were purple, and there was extensive necrosis along the free margin.

The lymphatic glands below the jaw, particularly on the left side, were swollen sufficiently to produce marked disfigurement. Two days after the injection of 0.3 grain of sodium arsphenamin the child could open his mouth without discomfort and eat semisolid food, and in four days recovery was practically complete, though there was still some discharge through the operation wound.

COMMENT

In ten of the twenty-five cases there were, in addition to the gingivitis, small ulcers on the tongue or on the internal aspect of the cheeks similar to those described at the beginning of this article. In six of the ten cases these ulcers were benefited little if at all by the arsenical medication, since they persisted for several days after the gums had completely healed. In these instances, the administration of potassium chlorate was followed by healing of the ulcers in from two to five days. It seemed probable that this process was not due to an infection by Vincent's organisms, and this impression was considerably strengthened when four additional cases presenting only ulcers answering the foregoing description were examined bacteriologically. In none of the four cases could spirilla or fusiform bacilli be demonstrated, and none of them showed any improvement following an intravenous injection of arsenic. The smears from these ulcers showed, as a rule, numerous pus cells which seemed to point to the probability of an infection by one of the pyogenic organisms.

CONCLUSIONS

1. Twenty-five cases of ulcerative stomatitis due to infection by Vincent's organisms were treated by arsenical compounds either intravenously alone, or combined with local applications. One patient died shortly after the injection as the result of an intercurrent disease. The other twenty-four were cured in an average of five and one-half days after the first injection. The cure in every case appeared to be permanent.

2. In 40 per cent. of the cases the gingivitis was accompanied by ulceration of the mucous membrane of the tongue and inner aspect of the cheeks. These ulcers, as a rule, did not appear to respond readily to the arsenical medication, and it is probable that they were not a manifestation of the same infection which produced the gingivitis but rather the result of a secondary pyogenic infection.

THE TREATMENT OF VASCULAR NEVI WITH RADIUM *

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Vascular nevi may be divided, from the standpoint of radium therapy, into four types: (1) flat angiomas, superficial and level with the skin; (2) flat angiomas, level with the skin but deeply infiltrating the cutaneous and subcutaneous tissue or mucous membrane; (3) angiomas which are elevated to a greater or less degree with smooth and papillated surface; (4) soft and pulsatile angiomas with fluctuating areas, and (5) erectile angiomatous tumors situated under the skin or in the mucous membrane.

Most of the cases that came under our observation belong in the third group, some in the fourth and fifth groups and a few in the second group. The few attempts made to treat the superficial flat angiomas (port wine marks) with radium met with indifferent success and were not continued for sufficient time to warrant comment.

The type of lesion treated in this study may be classed as raised capillary hemangiomas. Some, however, were markedly pulsatile; nearly all showed distention on exertion and might correctly be considered clinically as cavernous hemangiomas.

These lesions are really congenital; but the term is somewhat confusing, as angiomas are frequently insignificant at birth and occasionally are not noted until the second or third week of life. A certain number disappear spontaneously; but a larger number tend to increase rapidly in size as age advances. The color is usually a violaceous red, but may vary from a bright red to a deep violet. The surface may be smooth but is usually rugose. The skin over the lesion is thin and easily traumatized, so that ulceration and hemorrhage are frequently noted.

The majority of the patients were infants or young children from the outpatient service of one of us at the Babies' Hospital. Others were referred from the service of Dr. J. A. Fordyce at the Vanderbilt Clinic. The treatment was given in the dermatologic service of the outpatient department of the Presbyterian Hospital, New York. These cases were naturally selected as being best suited for radium treatment. The lesions amenable to other forms of therapy were referred to surgeons or treated by other dermatologic methods. The radium used was in the form of tubes of 25 and 50 mg. No filtration was used other than the silver capsule in which the glass tube of radium is contained.

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An effort was made to regulate the dosage and the quality of rays by varying the distance between the tube and the skin. The tubes were embedded in a square of wax and attached to the skin by straps of adhesive tape. Dental wax is sold in sheets one-sixteenth inch thick and, when warmed in hot water, is easily molded into any desired form. The wax usually interposed between the radium and the skin was from one-eight to one-half inch thick. The duration of a single application varied between one-half and two hours, and the amount of radium used varied between 25 and 200 mg. When more than one tube was utilized, care was taken to see that the tubes were separated by a

Location of Lesions Treated in Thirty-Three Cases *

Head:		26
Scalp	4	
Ear and adjacent integument	4	
Face		
Forehead	5	
Eyelid (upper)	3	
Eyelid (lower)	2	
Cheek	5	
Lip (upper)	1	
Lip (lower)	2	
	—18	
Body:		17
Shoulder	1	
Chest (anterior)	3	
Abdomen	2	
Back	2	
Arm	3	
Hand and Fingers	1	
Buttocks	2	
Thigh and Leg	3	
	—17	
Total number of lesions treated		43

* Three of these patients had multiple nevi; one patient presented five.

distance of at least 1 cm. An effort was made to secure a cross-fire effect by applying the radium tubes on opposite sides of the nevus when the lesion was in a favorable location or sufficiently raised to allow it. No treatments were given without an interval of at least three weeks, and, if any skin reaction was noted at the end of this period, the treatment was deferred until all inflammatory signs had disappeared.

No claim is made that the method of using radium in these cases was ideal. Some authorities believe that all these lesions should be treated with radium plaques and that certain types should be treated with toiles. Many radium workers always use filtration with brass, lead, wood,

paper, etc. An effort was made to secure satisfactory results without filtration (except such as could be secured by distance) because the whole subject of filtration is in such an indefinite state that it is hard to estimate the dosage actually delivered through various substances of variable thickness at varying distances. The use of filters of any potency calls for such a lengthening of the time of individual treatments that it would be impracticable at a clinic where a number of cases had to be treated in the course of a few hours. In private practice larger doses

Fig. 1 (E. S., aged 1 year).—Hemangioma of the upper lid, the size of a quarter; raised, bright red in color. The child is unable to elevate the lid.

with a longer interval between treatments and with distance somewhat increased seem desirable; but no damage other than superficial exulcerations in one or two cases has been noted. These healed without inconvenience or noticeable scarring.

Several patients are still under treatment and are making satisfactory progress. In completed cases the average number of treatments given was fifteen; the average interval, twenty-four days, and the average dosage in milligram hours, 40. The average distance between the

radium and the skin was one-fourth inch. When erythema or crusting has followed treatment, it has been attributed to too short a distance from the skin, rather than to the amount of radium used or the duration of the treatment.

The angiomas varied in size from that of a dime to that of the palm; most of them were raised above the skin level, some as much as 1 cm. Eight of the lesions had ulcerated before the patients came for treatment. Of these patients three had had spontaneous hemorrhages.

Fig. 2. (E. S.).—Nineteen months later, after twenty-one applications of radium; total milligram hours, 333; average dose, 28 mg. hours; slight superficial ulceration at first period which healed in one month. Result of treatment excellent; no red areas remaining; lid now has perfect function.

One case had previously been treated with carbon dioxid snow with some slight improvement. The remaining cases were uncomplicated. The average age of the patients at the beginning of treatment was 14 months. The most rapid and satisfactory results were obtained in the younger children.

No attempt will be made to record in detail the results obtained, since the number of cases treated is not sufficiently large to justfy any conclusions. The end-results are always a matter of personal opinion, and the possible results by other methods of treatment are always open to argument.

The fact that most of these patients remained under treatment for periods of from six to eighteen months justifies the belief that the parents were satisfied with the progress made and were willing to spend the time and effort involved in keeping appointments rather than in seeking more rapid methods of treatment. Several illustrations with

Fig. 3 (V. H., aged 9 months).—At birth a small bluish area was noted on the inner angle of the uper lid; this became progressively larger and began to swell at the age of 4 months. When the radium therapy was begun the tumor was 1 cm. in depth and width.

notes on the treatment give a fair idea of the end-results in certain favorable cases. Photographs are not entirely satisfactory records of the progress of these cases because of the difficulty of making red register at its proper value on ordinary photographic plates.

COMMENT

A fairly uniform experience warrants the generalization that, other things being equal, the younger the patient, the better and more rapid

are the results under radium therapy. This point needs emphasizing because of the general practice of physicians of advertising postponement of treatment until the child has at least reached school age. Angiomas are much more refractory in adults than in children. In the former, they are really organized tumors. Healing can be obtained only by combining the specific effects of radium with its destructive properties.

Another point that should be noted is the following: The presence of ulceration and hemorrhage is not a contraindication to the use of

Fig. 4 (V. H.).—Same patient as in Figure 3, after three applications of radium.

radium. Ulcerating and bleeding areas healed with remarkable rapidity after one or two such treatments. In the cases in which overtreatment produced exulcerations, no hemorrhages were noted, and the areas healed without local applications and practically without scarring.

In the therapy of vascular nevi, a fairly wide range of selection is open to the physician: surgery, the electrolytic needle, electrocoagulation, carbon dioxid snow, caustics, ultraviolet light, roentgen rays and radium. These have all been used with varying degrees of success, depending on

Fig 5 (V. H., aged 20 months).—After seven applications of radium.

Fig. 6 (A. L., aged 1 year).—Before begining radium therapy. Tumor is elevated 2.75 cm. above the surface of the arm. Tortuous vessels may be seen which extend to a point, 4 cm. from the right sternal border. The tumor is broken down at the lower inner quadrant. The mother states that it has broken down and discharged on several occasions.

the location, type and size of the nevus and upon the skill of the operator. Since this type of new growth rarely endangers life, the problem becomes one of obliterating the abdominal blood vessels with the least possible damage to the surrounding tissues and the best cosmetic result, due regard being had to the amount of discomfort caused, the time consumed and the expense involved.

A skilful surgeon can remove small nevi in favorable locations with surprisingly insignificant scars. This method has the advantage of

Fig. 7 (A. L.).—Same patient as in Figure 6, after fourteen treatments with radium.

completing the eradication of the growth at one operation. There are certain disadvantages.

There is always a possibility that the growth may recur if all the abnormal vessels are not removed. Keloids may develop in the scar. Infection, with failure of primary union and a more unsightly scar, may occur. If the lesion is extensive, secondary skin grafting may be needed, and, even with an excellent take, from the surgeon's standpoint, the cosmetic effect and sensory result may not be satisfactory.

In our experience, if the lesions are on the face or in regions where the skin is tightly stretched or if they involve an extensive area elsewhere on the body, particularly if there is involvement of blood vessels surrounding the lesion, the surgeon of long experience is quite likely to decline to attempt the removal of these growths.

The electrolytic needle is the method of choice in the treatment of spider nevi and telangiectasia in general. When used on the larger growths, much depends on the skill of the operator. There is usually

Fig. 8 (A. L., aged 2½ years).—Same patient after twenty-one treatments with radium; no discharge since treatment was instituted. At the distal end, angleworm vessels are still present. At the middle third, there is an area of skin resembling cigaret paper resulting from overdosage. The tortuous vessels previously present on the chest have entirely disappeared.

some scarring. In any case it is almost impossible to obtain a uniform effect over an area larger than the end of a lead pencil, and, when used on larger lesions, an unpleasant mottling is likely to be the end-result. The treatments are painful and time consuming.

Electrocoagulation is one of the newer methods of treatment and has much to commend it. Few men have had enough experience with it

to use it successfully. In any case it involves the ability to determine in advance the limits of the growth, and this in certain cases offers a difficult problem. If it were possible to locate the main vessels supplying the nevus and obliterate them by this method, it is conceivable that a perfect result might be obtained.

For the cavernous types of angioma of moderate size with a hard background, such as the bones of the skull or any other bony background or even firm muscle that exerts counter pressure, carbon dioxid snow is probably the method of choice. The operation in itself is usually a painful procedure, and in certain cases marked constitutional disturbance may persist for several days following its use. If the time and pressure factors are properly estimated, an excellent result may be obtained. The use of carbon dioxid snow presupposes the necessity of destroying the covering of the blood vessels and replacing it with scar tissue. When the nevus is too large to be covered at one application, the possibility of uneven treatment or of overlapping treatment must be borne in mind.

The use of caustics, either acid or alkaline, is becoming less common. The method has no advantages over other forms of therapy, and sometimes unsightly scars result.

Treatment of port wine marks by the use of the Kromayer lamp has given good results in the hands of a few, expert in its use; most patients become discouraged because of the large number of exposures required and the slow improvement observed.

The treatment of vascular nevi by means of the roentgen ray is no longer in vogue. While most clinicians are inclined to believe that the same effect can be produced with the roentgen ray as with radium, these vascular new growths are a stumbling block in the way of a sweeping generalization, for their response to radium is much more prompt and complete. The roentgen ray is known to have a selective action on lymphoid tissue; apparently radium has, in addition, a selective action on the vascular endothelium of these nevi which the former does not possess.

Pinch [1] gives the following explanation of the action of radium on vascular tumors:

> Prolonged intensive radiation of blood vessels with radium is productive of proliferation, vacuolation, and degeneration of the endothelial cells, with leukocytic infiltration of the walls, and subsequent distortion of their caliber.
>
> If, however, the radiation be of mild degree, acting for but a short time at prolonged intervals, multiplication of the endothelial cells with increased fibrosis of the vessel walls occurs. These changes result in a definite narrowing, perhaps even obliteration of the lumen of the smaller vessels and it is in this fashion that the cure of angiomas is induced.

1. Pinch, A. E. H.: A Report on the Work Carried on at the Radium Institute, London, from Jan. 1, 1920, to Dec. 31, 1920, Radium **17**:192 (Sept. 6) 1921.

The skin over angiomas of the type under discussion is rarely normal. In certain subcutaneous forms and in some lymphangiomas the skin is not abnormal, and it is possible to cause their regression without appreciable damage; but in the reddish or violaceous lesions, the skin is definitely thinner and more fragile than normal. The sebaceous, sweat and hair glands are scanty or absent, and even if the afferent blood vessels are ligated or destroyed by an electric current or heat, so that the nevus is obliterated, the remaining covering will not approximate normal skin. Therefore, it is evident that a perfect cosmetic result is not possible and that the method of choice is either surgery or some other form of treatment that will destroy the overgrowth of blood vessels, with a minimum of damage to the delicate overlying structures.

SUMMARY

In our experience the disadvantages and advantages of radium in the treatment of these angiomas are these: Radium therapy is expensive and time consuming—both because of the necessity of individual treatments and because of the long intervals between treatments. There is also the chance of overtreatment, with subsequent ulcer formation and very tardy healing. The possibility that telangiectasia and an atrophic skin may result, followed later by keratosis and epithelioma, has also to be considered.

The advantages of radium treatment are the freedom from pain, the very gradual changes in the lesion which can be watched from treatment to treatment and the probability of causing the lesion to disappear without appreciable damage to the overlying skin. In addition, there is the advantage of rapid healing of ulcerations and hemorrhagic areas, the absence of scarring, under favorable conditions, or, when scarring is unavoidable, the production of a smooth, supple and comparatively inconspicuous scar. It is possible to treat successfully lesions that, because of their location are not suited to other procedures; for example, nevi of the eyelids, or others on account of their depth and extent. Most potent of all reasons for using radium in treating angiomas is the fact that radium exerts a definite, specific, selective action on the abnormal endothelial cells lining the blood vessels which are at fault in the process. Apparently, this is not true of any other therapeutic agent at our command.

Not all angiomas respond equally well to radium treatment. The port wine mark in very obstinate, since flat nevi generally are more refractory than the raised. Many nevi of small size and situated on covered parts are easily destroyed by more rapid methods.

The scar following the skilful use of carbon dioxid snow is often insignificant. Telangectasia, classed as nevi, is better treated by electrolysis. Surgery often gives brilliant and rapid results.

In certain selected, raised vascular nevi of the face, radium therapy yields results which probably cannot be achieved by other methods, especially if the treatment is commenced in early infancy.

ATRESIA OF THE DUODENUM AND RIGHT INTERNAL HERNIA

REPORT OF A CASE *

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The occurrence of congenital atresia along the gastro-intestinal tract is by no means a rare condition, Davis and Poynter [1] having assembled the reports of 392 cases of occlusion between the pylorus and anus. A further analysis shows that the duodenum is the site of predilection, as the lesion was found there in 134 cases of the series.

Right internal hernia, on the other hand, is a condition which warrants report whenever it is found, since Moynihan [2] was able to collect but seventeen cases in 1906, when his classical monograph appeared. Herniation into the infraduodenal fossa, according to this author, is the rarest of all the types of internal hernia. Armand,[3] in his Thèse de Lyon, 1903, reported the only case so far on record.

The subjoined case is presented because of the combination of the two foregoing defects in one individual; because of the rarity of such a finding, and also for the purpose of discussing the associated features of interest to clinicians in making an early diagnosis in such cases.

REPORT OF CASE

History.—A boy, born at full term, May 2, 1922, at 4:20 a. m., with spontaneous delivery, was normal in outward appearance. The following morning he began to vomit a dark brownish material, which appeared to be blood streaked. He had one normal bowel movement. Vomiting continued throughout the day.

Examination.—Dr. Grover Powers saw the baby the following morning. He was small, slightly jaundiced and did not appear to be premature. He looked ill and vomited frequently, the vomitus being a peculiar brownish fluid which suggested a mixture of blood and meconium. Benzidin and guaiac tests of this material were positive. Peristaltic waves were observed moving across the prominent abdomen below the umbilicus, from the left hypochondrium to the right iliac region. Careful examination of the lungs revealed nothing abnormal, the question of diaphragmatic hernia being considered. Dr. Powers concluded that in view of the history and the age of the patient and because of the marked peristaltic waves, the most probable diagnosis was an intestinal obstruction of a congenital nature and the most likely location, the duodenum. He suggested

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* Received for publication, March 26, 1923.

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1. Davis, D. L., and Poynter, C. W. M.: Congenital Occlusions of the Intestines, Surg., Gynec. & Obst. **34**:35-41 (Jan.) 1922.

2. Moynihan, B.: On Retroperitoneal Hernia, New York, 1906.

3. Armand, Cited by Moynihan (Footnote 2).

a duodenal atresia as the cause; but from his findings, especially the location of the peristaltic waves, he could not be sure that the obstruction was not lower down in the intestinal tract.

Dr. Edwards Park, who later saw the baby, felt that there was a duodenal atresia. He cleared the question of the nature of the peristaltic waves by the introduction of water into the stomach, which demonstrated conclusively that this organ was unusually dilated and extended as far down as the brim of the pelvis. After water had been introduced, there was a marked succussion sound over apparently the entire abdomen. Another point of interest was that the stomach tube could be plainly felt through the abdominal wall below the umbilicus. This was very easily demonstrated when it was partially withdrawn. By forcing air into the stomach its dependent position and great dilatation could be made out.

The report of the roentgen-ray examination made by Dr. Scott, after barium had been introduced, was as follows: "Plate and fluoroscopic examination of the stomach shows a well marked definite and total obstruction in the duodenum, approximately 2 cm. from the pyloric opening. Practically no barium sulphate passes this point in thirty minutes times" (Fig. 1).

The patient was seen in consultation by Dr. Morton, who concurred in the diagnosis and performed an exploratory laparotomy a short time later.

Diagnosis: Congenital obstruction, second portion of duodenum.

Operation.—May 22, 1922, a split right rectus incision was made under procain anesthesia. When the peritoneal cavity was opened, a very large liver appeared, the lower edge of which was at the level of the umbilicus. Accordingly, it was necessary to enlarge the incision downward to the right of the stump of the umbilical cord. When the liver was retracted upward, a large dilated stomach was encountered with a markedly distended loop of duodenum beyond the pylorus. The appendix and cecum had not descended into the right lower quadrant but occupied a position near the gallbladder. The transverse colon was a very narrow strip of bowel adherent to the stomach by a thin veil of tissue. A band consisting of five or six loops of small intestine occupied the right portion of the abdominal cavity, whereas the entire large bowel was present in the left portion, apparently neither the large nor small bowel having rotated completely. Following the small intestine from the ileocecal valve upward, it was observed that about one half of the small intestine remained behind a thin walled pouch on the right side of the abdomen. By gentle traction, the bowel could be seen through this thin layer of tissue unfolding itself and coming out into the open. At one portion about 2 inches of the small bowel was of a purplish color; but when it was released from its abnormal position the circulation quickly returned. By continued traction the entire small intestine was freed. Immediately vigorous peristalsis set up in the dilated duodenal loop and air appeared to pass from this portion of the intestine, which became smaller in size. The operator then attempted to find the opening of the hernial sac; but this was not possible as it had collapsed and could not be demonstrated. The small intestine semed to emerge in its normal position at Treitz's ligament, and the obstruction appeared to be relieved.

Closure was made in layers: fine catgut being used for the peritoneum; stay sutures of silkworm gut were introduced; chromic catgut was used for the fascia, fine plain catgut, subcutaneously, and silk for the skin. Before complete closure was accomplished, about 200 c.c. of physiologic sodium chlorid solution was introduced into the the peritoneal cavity.

The patient stood the operation well, lying quietly on the table with no struggling throughout the procedure. His condition on return to the ward was practically the same as before operation.

Course.—Following the operation, he received 30 c.c. of citrated blood into the longitudinal sinus in order to combat the melena neonatorum. Small amounts of water and breast milk to which sugar was added were given during the subsequent twenty-four hours. The child vomited a little during the

first twelve hours after the operation. As time went on, however, he began to vomit more, the vomitus consisting of a frothy blood stained fluid. Dr. Powers, who was again called in consultation, considered that the baby had pulmonary edema. Death ensued at 6:30 p. m., May 23, 1922.

Necropsy.—This revealed a few patches of bronchopneumonia, but little else of interest except the abdominal condition.

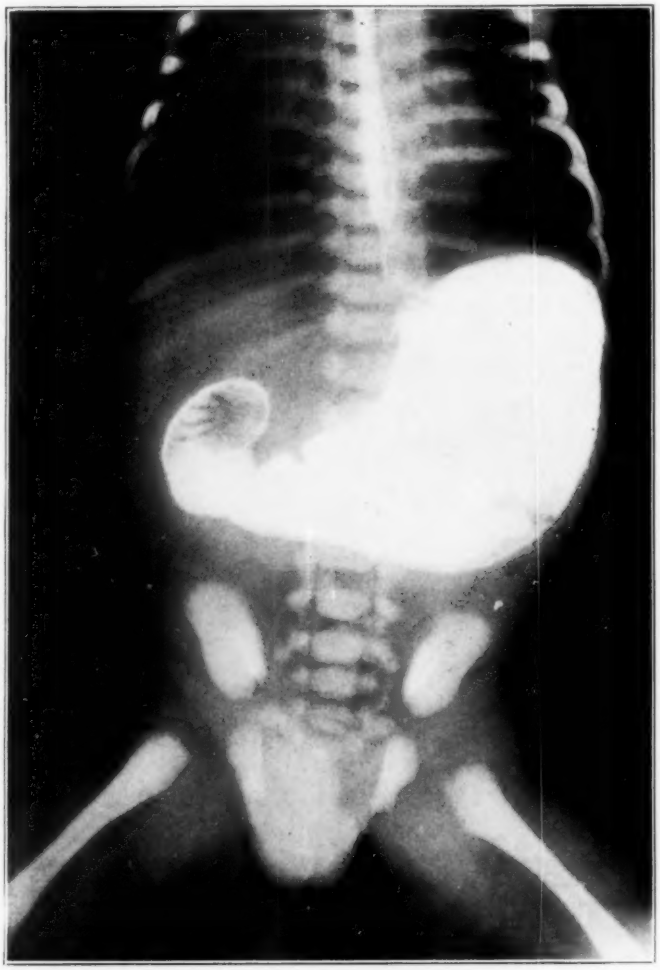

Fig. 1.—Hugely dilated stomach, pyloric constriction and dilated loop of duodenum revealed by barium sulphate meal.

Because of the history the abdominal organs were carefully examined in situ. The stomach was greatly dilated with gas. This dilatation extended into the first part of the duodenum and then abruptly stopped, and no gas could be forced beyond this point. The small intestine was pale in color and appeared entirely collapsed. A careful search was made on the right side of the abdomen for the hernial sac which had been discovered at operation. Several rather loose bands of peritoneum were found, but no definite sac. There was a wide peri-

toneal band which ran from the colon across the posterior abdominal wall and was attached along the anterior surface of the kidney. Just above the lower pole of the kidney this fold ended, and there was an opening which led between the two peritoneal layers of this band. This probably represented the sac found at operation. Because of the obstruction in the duodenum at about the level of the ampulla of Vater, liquor formaldehydi was injected into the stomach in an attempt to find whether there was a small lumen through which fluid could be made to pass under pressure. No fluid went through. In the same way, liquor formaldehydi was injected under pressure through the duodenum, but it did not pass into the stomach. The abdominal organs were removed as a whole and allowed to become fixed. When the duodenum was opened, the upper part was found to end in a blind sac which formed the point of obstruction. The intestine below was patent but had no connection with the stomach or upper third of the duodenum. The other organs showed nothing of note, so they were left in situ to preserve the relationship of the hernial sac.

COMMENT

The clinical picture of a day old baby vomiting at intervals throughout twenty-four hours offers a problem for early differential diagnosis, the solution of which may be the means of saving the child's life. The character of the vomitus in the case reported, bile stained and blood streaked, pointed to an intestinal obstruction, high in the gastrointestinal tract. The conditions most likely to be responsible for such an obstruction are stenosis, atresia or internal hernia. Hypertrophic stenosis of the pylorus was ruled out in this case by the fluoroscopic examination of the barium sulphate meal, which demonstrated that the opaque medium passed through a normal pyloric ring into a dilated duodenal loop. It is interesting that such well marked peristaltic waves were present in the stomach, though this finding has been noted in other cases of atresia of the intestine. Tumor of the pyloric region, which could not be palpated in this child, has also been described and has served to make the differential diagnosis more difficult. The presence of a markedly dilated stomach was very clearly demonstrated by Dr. Park on introducing water through a stomach tube, a method easily available to any practitioner, giving an accurate outline of the stomach in relation to the other viscera. The dilatation of the stomach, the peristaltic pattern and the early vomiting, all favored an obstruction, and the fact that no barium sulphate passed a point 2 cm. from the pyloric end indicated that it was complete. Bile in the vomitus has been reported even when an atresia has been present above the ampulla, owing to the presence of an accessory bile duct (Cordes [4]); it has also been found in the feces in several cases in which the atresia was below the opening of the common duct. The argument advanced for these cases is that the occlusion could not have become complete until sometime after the establishment of bile secretion. This begins normally in the third month.

4. Cordes, L.: Congenital Occlusion of the Duodenum, Arch. Pediat. **18:** 401-424 (June) 1901.

From an operative standpoint, the features of interest were the ease of exploration under procain anesthesia and the numerous evidences of developmental anomalies. These were manifested in the position of the cecum and appendix in the neighborhood of the gallbladder (deficient migration); the attachment of the omentum along the entire colon; the failure of complete rotation so that the ileum entered the cecum from the right instead of from the left; the hugely dilated stomach and

Fig. 2.—Relationship of organs found at operation: large stomach and duodenum, cecum and appendix in the region of the gallbladder, the ileum entering the cecum from the right side, and the herniation of a portion of the small bowel through a thin walled peritoneal sac.

duodenum, and the presence of an internal herniation of about half of the small intestine to the right of the median line. The anomalies of migration, descent, etc., have been admirably summarized and presented by Harvey.[5] The hernia occupied a position bounded roughly by the

5. Harvey, S. C.: Congenital Variations in the Peritoneal Relations of the Ascending Colon, Caecum, Appendix and Terminal Ileum, Ann. Surg. **67**:641-686 (June) 1918.

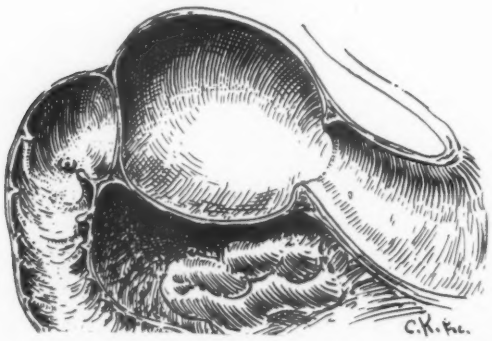

Fig. 3.—Cross-section showing the diaphragm across the duodenum above the papilla of Vater.

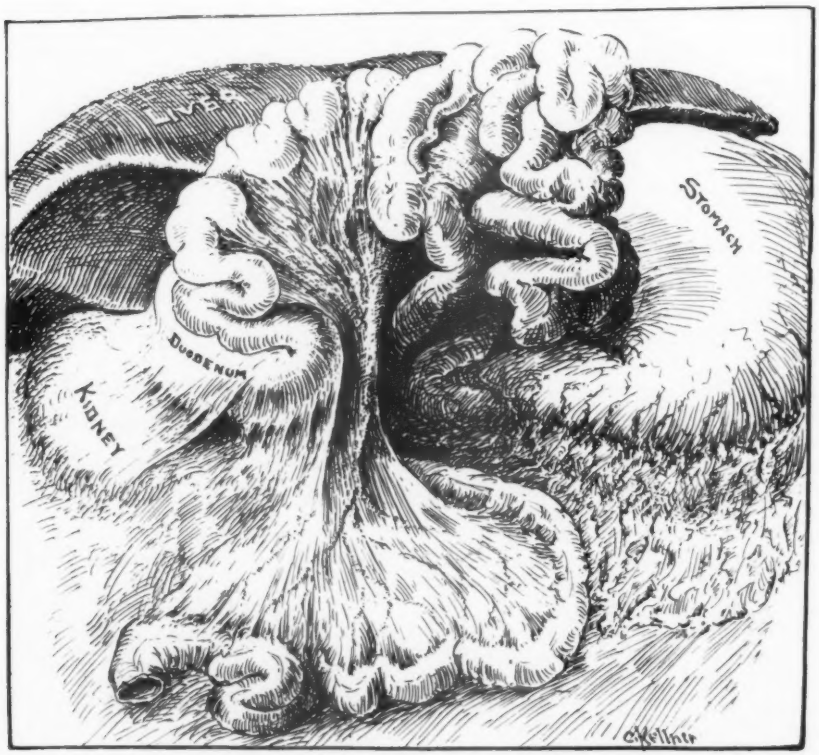

Fig. 4.—Orifice of sac to the right of the attachment of the mesentery, showing the relation of the duodenum and the right kidney to the sac.

right kidney, inferior surface of the liver and the second portion of the duodenum. There was a filmy veil of tissue through which the small bowel was easily seen uncoiling and coming into the open on gentle traction (Fig. 2). On complete reduction vigorous peristalsis started up in the released intestine and, to all present at the operation, the dilated duodenum and stomach appeared to become smaller so that the cause of the obstruction was believed to be removed. The only way

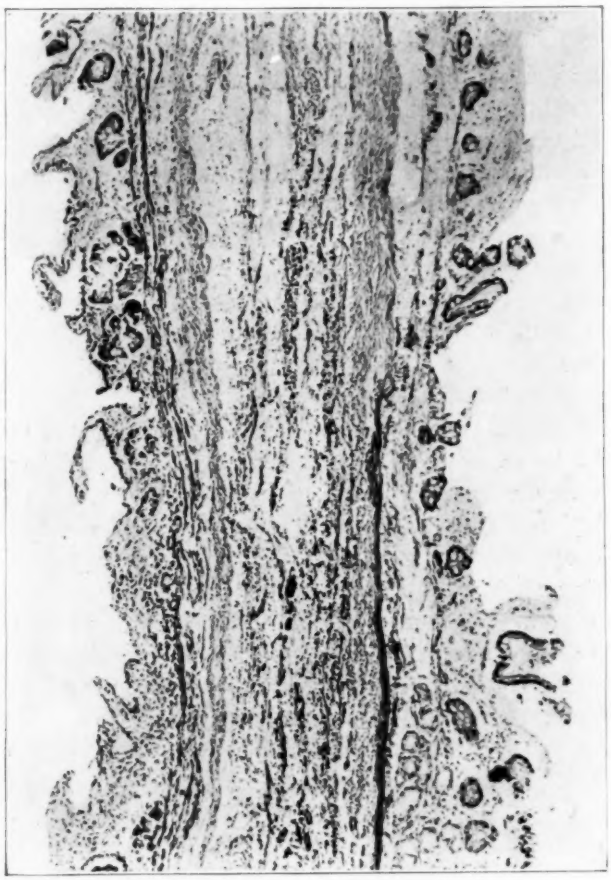

Fig. 5.—Microscopic section of membrane across the duodenum, showing the mucosa on each side, glands, submucosa and intestinal villi.

that the operator can account for this observation is that considerable pressure was exerted upward to draw the large liver and dilated stomach out of the field. This may have emptied the air from the stomach through the mouth. Necropsy showed that there was an unbroken diaphragm across the duodenum above the ampulla (Fig. 3) so that there could have been no passage of material into the intestine

from above this point. The greatest interests centers in the location of the hernial sac. It was very difficult to find the opening at necropsy; but it was finally demonstrated as a fold of peritoneum bridging the space, from the second portion of the duodenum to the lower pole of the right kidney. In this situation, the opening looked downward and to the left. There was no vessel of any kind in the reflected edge of peritoneum, a fact which is incompatible with the ordinary type of right internal hernia described by Moynihan.[2] This type requires either the superior mesenteric artery or its continuation, the ileocolic in the anterior margin of the sac. The description fits more nearly that of the infraduodenal fossa described by Armand,[3] in that the anterior boundary of the sac did not contain a vessel. It differs in one particular, however, namely that the orifice was situated to the right of the attachment of the mesentery, whereas in Armand's case it was to the left of this structure (Fig. 4).

A possible explanation of the occurrence of such a hernial sac lies in the fact that the posterior layer of the mesentery of the duodenum normally becomes fused to the posterior abdominal wall in the third month and loses its identity. Failure to undergo this fusion would leave a space much the same as that under discussion.

In regard to the surgical procedure to be used in an atresia of this kind, it seems to me that an incision parallel to the long axis of the affected bowel crossing the diaphragm, with complete removal of the membrane and suture of the incision transversely, as in a Heineke-Mikulicz pyloroplasty, would be the operation of choice. The two successful operations on record for atresia consisted in gastro-enterostomy and duodeno-entero-anastomosis.[6] These elaborate operations are absolutely essential for some cases; but, when there is an obviously patent lumen both above and below the point of obstruction, the danger of infecting the peritoneum is so slight in the upper intestine that an exploration of the obstructed site would seem indicated. In this way a simpler operation might be performed.

Microscopic section of a portion of the membrane showed normal mucosa and glands on either side. Villi were also well developed and a submucosa backed up to a similar layer with intervening loose areolar tissue (Fig. 5).

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6. Schroder, C. H.: Congenital Obstruction of the Duodenum, J. A. M. A. **78:**1039-1041 (April) 1922.

MYELOGENOUS CHLOROMA

REPORT OF CASE WITH NECROPSY *

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AND
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CINCINNATI

The case herewith reported is of interest, first, because few instances of chloroma are published each year (only three in 1922), and, secondly, because the symptoms in this child all pointed to cerebral lesions and diverted the attention of the clinicians from the underlying condition. No superficial tumors were present, an unusual feature which further added to the difficulties of diagnosis, although the blood smears were typical of acute myelogenous leukemia. It is also interesting to note that the testis and epididymis were invaded by the tumor, these having been reported hitherto as being involved in only one instance.[1] The diagnosis had been abdominal spasms, worms and poliomyelitis before admission to the Cincinnati General Hospital; after admission, it was a question whether the case should be considered lymphogenous chloroma or encephalitis with a severe anemia.

Our knowledge of chloroma dates back to 1854, when it was first described by King,[2] who gave it its name. It was not until Türck's [3] paper appeared in 1903 that a myelogenous, as well as a lymphogenous, type was recognized. This idea was further elaborated by Klein and Steinhaus,[4] and reached its fullest development when Askanazy [1] declared that the majority of, if not all, chloromas were myelogenous. An historical account of the development of the theories concerning the disease will be found in the paper of Rowe and Hirschboeck.[5] More elaborate discussions in German are those of Fabian,[6] Roman [3] and Askanazy.[1]

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* Received for publication, April 9, 1923.
* Read before the Cincinnati Academy of Medicine, April 16, 1923.
* From the Departments of Pathology and Pediatrics, University of Cincinnati College of Medicine and Cincinnati General Hospital.

1. Askanazy, M.: Beitr. z. path. Anat. u. z. allg. Path. **63**:22, 1917.
2. King: Month. M. J. **2**:385, 1854.
3. Türck, cited by Roman, B.: Beitr. z. path. Anat. u. z. allg. Path. **55**:61, 1913.
4. Klein, K., and Steinhaus, J.: Zentralbl. f. allg. Path. u. path. Anat. **15**:49, 1904.
5. Rowe, O. W., and Hirschboeck, F. J.: Myeloid Chloroma, Am. J. Dis. Child. **24**:239 (Sept,) 1922.
6. Fabian, E.: Beitr. z. path. Anat. u. z. allg. Path. **43**:172, 1908.

As outlined by Ewing,[7] chloroma may be divided into two types, lymphogenous and myelogenous, of which the former is more common. It occurs chiefly in young males, averaging 18.8 years of age; runs an average course of 5.5 months' duration, and terminates fatally. It appears principally in the ribs, dura, dural sinuses, sphenoidal and ethmoidal sinuses, ear, nose and throat. It often invades the sternum, vertebral column, pelvic bones and occasionally the long bones. In such cases, the distinction from myeloma is not clear. The facts that myeloma usually occurs in the fourth and fifth decades, rather than in youth, and that the blood picture in that disease is more definitely aleukemic help somewhat in distinguishing the two conditions. In myeloma there are Bence-Jones albumoses in the urine, while in chloroma there are not. Chloroma involves the lymphatic system; the cervical, axillary, mediastinal and deep chains of nodes suffering almost invariably. They have escaped in but one myeloid case. Of the other organs involved, the pancreas, thyroid, thymus, ovaries, mammae, prostate, bladder, testis and epididymis have been described as the site of tumor-like growths. A tendency to infiltrate the tendinous insertions of skeletal muscles has been noted. The color of the tumors is a grass-green, or apple-green; but colorless tumors have been noted by Rowe and Hirschboeck [5] and by Birk, Leber and Wende and Miller (quoted by these writers). When the greenish color is present, it tends to fade after a time, or after fixation; but it can often be brought back by treatment of the tissue with hydrogen dioxid. Its nature has been the subject of much speculation and is still not understood.

The blood picture varies extensively. The lymphatic type shows a lymphocytosis; the myeloid type may show myelocytes, myeloblasts or cells even more primitive than the latter. The number of leukocytes varies from 6,100 in Caronia's [8] case, to 491,000 in Stevens'.[9] A consideration of the leukocyte counts in our case demonstrates that this may undergo wide fluctuations in a given instance, so that one must be very cautious in drawing conclusions from a single example. Ewing says: "The process belongs with the systemic sarcomas of blood-forming organs, affecting primarily either the lymphatic system, or the bone marrow." In discussing a case of lymphadenoid sarcomatosis of the ileum, Warthin [10] pointed out the close relationship between such tumors and the leukemias, which are now considered to be tumors of the blood stream. Chloroma has been known to occur in conjunction with tuberculosis, but there is no evidence that these two conditions are related.

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7. Ewing, James: Neoplastic Diseases, Ed. 2, Philadelphia, W. B. Saunders Company, 1922, pp. 363-364.
8. Caronia, G.: Pediatria **30**:437 (May 15) 1922.
9. Stevens, quoted by Ewing (Footnote 7).
10. Warthin, A. S.: Tr. A. Am. Phys. **19**:419, 1904.

The symptomatology of the disease is well summarized by Dock,[11] who says: "Out of the protean symptoms of chloroma cases we can separate three sets of conditions: the mechanical results of the green growths, causing many symptoms, both objective and subjective (exophthalmos, visible tumors, pain, deafness, etc.); the toxic symptoms, such as weakness, fever and emaciation; the blood symptoms, such as pallor, hemorrhages and alterations in the blood itself." As will be seen later, our case presents a syndrome chiefly referable to the second and third sets. The mechanical symptoms were never important, aside from the very misleading cerebral hemorrhage and its sequelae.

Few reports on chloroma have been published recently. Two of the cases reported have been myelogenous in type. The case reported by Rowe and Hirschboeck [5] was that of a child, aged 18 months, who had tumors about the zygomas, and the parotid, submaxillary and submental regions. Their necropsy findings have much in common with ours. The other case reported occurred in a boy, aged 3 (Caronia [8]). The chief interest in this instance is the presence of a nodular spleen, several tumors about the face and scalp and the ingenuity displayed in aspirating parts of the tumor for diagnosis by means of a coarse needle and aspirating syringe. The case terminated fatally, but did not come to necropsy. The blood count showed but 6,100 leukocytes, which is decidedly low.

Of the older articles, three in the German literature are of great value. Fabian [6] gives an extensive bibliography, reports two cases, one of each type, and discusses the disease at length. Roman [3] reports three cases in adults, one of them in "an old man" ("Greis") of 62. He has observed myelocytes in the germinal centers of lymph nodes, particularly in the tonsils, which he interprets as being produced there by metaplasia, as he could find but very few examples of migration into the centers by these cells from the blood capillaries. Our observations do not support this theory. In summing up, he points out the similarity of leukemia and chloroma, and in closing he says: "With the colored, as well as the colorless malignant leukemias, a perfectly typical blood picture is found, the blood picture of leukemia—they are, even to the greenish color, identical processes, but differ on account of their malignancy from simple, hyperplastic leukemic processes. In my opinion, it would be desirable to keep them separate and to reserve the term chloroleukemia only for the green, hyperplastic leukemias."

Askanazy's [1] last paper on chloroma gives an excellent and very complete summary of the history of the development of our knowledge

11. Dock, George, and Warthin, A. S.: Tr. A. Am. Phys. **19**:64, 1904; Med. News. **85**:971, 1904.

of the disease. He reports one case in which there were nodes in the kidneys, bladder and other organs. The tumor cells formed tumor thrombi in the sinuses of the dura, just as in our case. He considers these thrombi of the utmost importance in the differentiation of chloroma from an ordinary leukemia, a point not stressed by other writers. The bone marrow in his case showed extensive peripheral involvement. The tumor cells did not give the oxydase reaction; but, on account of the activity in the marrow and the lack of lymphogenous hyperplasia, he concludes that it was a myelogenous process. He found four types of crystals in the tumor cells, a fact hitherto and since not noted. There was no sign of hematopoiesis in the liver or spleen. He appears to believe that all cases of chloroma are myelogenous, his reasons being well founded and deserving of careful consideration. The current belief that the bone marrow is "invaded" by large lymphocytes, in the lymphatic type, according to his lights, is erroneous; he believes that the large, lymphocytoid cells found at the periphery of the bone marrow are produced there, rather than that they have migrated from the lymphatic system and are, hence, myelogenous in nature. This concept is borne out in our case; but the myelogenous nature of the process in this instance needs no discussion. In conclusion Askanazy writes: "Chloroma is extraordinarily similar to myeloid leukemia with green tumors, but it is not permissable to group them together until the etiological factor is understood, since noteworthy differences, for example their localization, exist. . . . Chloroma, like leukemia, is as a rule myelogenous. . . . The parent cell of chloroma is a hemoglobin-free member of the myelogenous cell series, or at least lies along the road to the development of the myeloid cell."

REPORT OF CASE

History.—J. H., a white boy, aged 3 years, was admitted to the pediatric service of the Cincinnati General Hospital, Sept. 22, 1922. Delivery had been normal and at term. He had been breast-fed and had had no contagious diseases. At 1 year of age he was circumcised. The mother was dying of carcinoma of the uterus. The father had had both legs amputated following an accident. A sister, aged 9, and a brother, aged 7, were alive and well. Four days prior to admission the child had a very severe nosebleed. Two days later, while playing, he stooped to pick up a clothes pin and fell into a pile of them that lay on the ground. About five minutes later he was found crying, his eyes rolled upward, his head turned to the left. He continued to cry for about fifteen minutes. Since then he had not uttered a sound. The right arm and leg became paralyzed. Apparently, he had not struck his head. There were bruises on the knees, but nowhere else. The next day he vomited and developed clonic contractions in the lower extremities and abdominal muscles. He became feverish.

Examination.—The boy was poorly nourished, semiconscious and was not aroused by noises. It was not possible to determine whether or not he saw. He cried out shrilly from time to time, as though he was in great pain. There were ecchymoses on both knees. No evidence of a fractured skull could be elicited. The eyelids drooped, the left more than the right. The pupils were equal and reacted to light. The tongue was heavily coated; the tonsils were large and

cryptic. There was general enlargement of the superficial lymph nodes. The heart, lungs and genitalia were normal. The liver was enlarged and extended a few centimeters below the costal margin. The spleen was not felt.

Neurologic Examination.—There was almost complete flaccid hemiplegia on the right side of the face, trunk, right arm and leg. Sensory functions were not impaired. The reflexes were normal on the left; there was a double plus biceps reflex and knee-jerk, a positive Babinski sign, and absent cremasteric and abdominal reflexes on the right, with negative ankle clonus and Kernig's sign.

Summary.—The findings pointed to a diagnosis of (1) right hemiplegia, (2) stupor, (3) aphonia, (4) general enlargement of lymph nodes, (5) large, cryptic tonsils.

Course of Illness in Hospital.—During the following two weeks there was a gradual amelioration of the symptoms, with a transient phase of spasticity and some changes in the pupillary reactions. At the end of the week, the child had a severe epistaxis that required packing anteriorly and posteriorly. During the following week the packing was removed several times, but as the bleeding persisted, despite the local application of a hemostatic, it had to be replaced. No bleeding point could be located, nor was any foreign body found. At the end of the week the hemorrhage was controlled, but the tendency to bleed persisted. There was slight oozing from the nares. A transfusion of 80 c.c. of citrated blood was given on the eighteenth day after admission. It was followed on the next day by vomiting, and blood was found by Meyer's test in the vomitus. Another transfusion was given on the twenty-second day, 85 c.c. of citrated blood being administered. The clotting time was then two minutes and fifty-six seconds. The patient's temperature rose to 102 F. after the transfusion, but soon fell.

Four weeks after admission, the boy's color had improved noticeably. By the fifth week, he began to grasp at objects, but developed a clonic twitching of the left arm which persisted for another month, gradually subsiding in intensity. Two months after admission he was talking, gaining in strength and playing with other children. The right pupil was larger than the left, and remained so until the end. Improvement continued up to the eighty-third day, when the patient refused food and was less lively and talkative. Reference to the table of blood counts made in this case reveals that the child had had a remission of the leukemia and was now entering upon another relapse. The temperature remained normal, but he began to vomit, the vomiting becoming projectile in character. The right hemiplegia persisted; the temperature rose to 100 F. About three months after admission, purpuric spots and nystagmus appeared in both eyes. Cheyne-Stokes breathing developed, and the child died.

Laboratory Findings.—Spinal Fluid: This was examined at intervals during his illness, five tests being made. It showed little except a marked increase in the cell count, which rose to 190 shortly before death. The blood Wassermann and Pirquet reactions were both negative. The urine was negative, containing no albumin or albumoses. Blood cultures were sterile. The blood count and results of the differential examination are given in Table 1 and 2.

Necropsy.—This was performed three hours after death. The body was that of a well built, poorly nourished white boy, apparently about 3 years of age. Rigor mortis and postmortem lividity were absent. Small petechiae were present over the ear lobes, right temple, both patellae and the left forearm. The right pupil was 6 mm., the left 5 mm., in diameter. The teeth, tongue and lips were covered with sordes. The cervical nodes did not seem to be much enlarged.

The liver was about 1 cm. below the costal margin. The diaphragm was at the fourth interspace on the right and at the fifth rib on the left. The thymus was small and shriveled, and of a peculiar apple green color. A few small hemorrhages were found beneath the adventitia of the pulmonary artery and aorta at their origin. The middle lobe of the right lung showed massive areas of hemorrhage, which varied in color from bright red to purple. Both lower

lobes showed extensive hemorrhages, particularly at the sharp border of their bases. The tonsils were large, and, on section, they presented the same apple green color noted in the thymus. They were homogenous in texture, and the crypts were large and patulous.

The spleen, liver and gastro-intestinal tract were not particularly remarkable. There were numerous hemorrhagic erosions in the gastric mucosa, with some old, coffee-ground blood adhering to them. All of the mesenteric nodes were enlarged and of the greenish color previously described. The mucosa of the

TABLE 1.—*Blood Counts*

Date	Erythrocytes	Leukocytes	Hemoglobin Per Cent.	Temperature F. (Maximum)	Comment
9/22		14,400		99.4	Admitted
9/23	4,567,000	19,200		102.4	
9/24	5,000,000	20,000		105.0	
9/29		16,000		99.2	
10/5	2,352,000	12,400	46	101.0	Epistaxis
10/9	2,400,000	16,400	40	101.0	Epistaxis controlled
10/11	2,000,000	11,600	38	99.6	First transfusion
10/13	3,100,000	11,400	36	99.5	
10/17	2,464,000	8,000	42	99.2	Second transfusion
10/23	3,000,000	9,200	52	98.8	
11/22	4,200,000	8,200	55	98.6	
12/11	5,660,000	40,800	60	99.0	Refuses food, sick
12/19	5,200,000	55,400	86	100 6	Died shortly after
Average	3,632,000	18,692	54	During observation	

TABLE 2.—*Differential Leukocyte Counts* *

Date	Polymorphonuclears Per Cent.	Lymphocytes Per Cent.	Transitionals and Large Mononuclears Per Cent.	Myelocytes and Myeloblasts Per Cent.	Normoblasts	Platelets
9/24	25	22	1	52	3	Dimin., large
10/5	14	46	2	38	6	Dimin., large
10/11	24	63	1	12	1	Much dim., large
10/23	38	50	3	9	0	Dimin., large
11/22	16	75	3	6	2	Incr., smaller
12/13	5	34	1	60	3	Dimin., large
12/19	4	18	0	78	8	Much dim., large
Average	28	44	1.57	36.43	3.3 per 200 cells	

pelvis of each kidney was also greenish, which microscopically was accounted for by diffuse tumor infiltration of the submucosa. On the posterior, inner surface of the urinary bladder, which was otherwise normal in appearance, were

* Myelocytes were always scarce and difficult to distinguish in many instances, therefore, they have been grouped with the myeloblasts. Poikilocytosis, anisocytosis, polychromatophilia and basophilia were present in the erythrocytes, the latter only during the last few days of life. The averages in the tables mean little, but they show that the blood never approached normal during the child's stay in the hospital.

several thickened areas of greenish, lobulated tissue, with punctate hemorrhages at their periphery. The testes were slightly enlarged and presented the same greenish hue, but, otherwise, they were not grossly remarkable. In view of the fact that they were almost two-thirds replaced by tumor tissue, as shown later, this was interesting. The bone marrow of the ribs was not particularly remarkable in its appearance, but that of the femur was pale, greenish and homogeneous.

When the scalp was opened, a fairly large hemorrhagic area appeared over the right temporal region below a puncture wound. The dura was adherent to the calvarium over the vertex and necessitated cutting before it could be freed. The brain weighed 1,125 gm. When it was removed, a large hemorrhagic area was encountered in the right parieto-occipital region, measuring

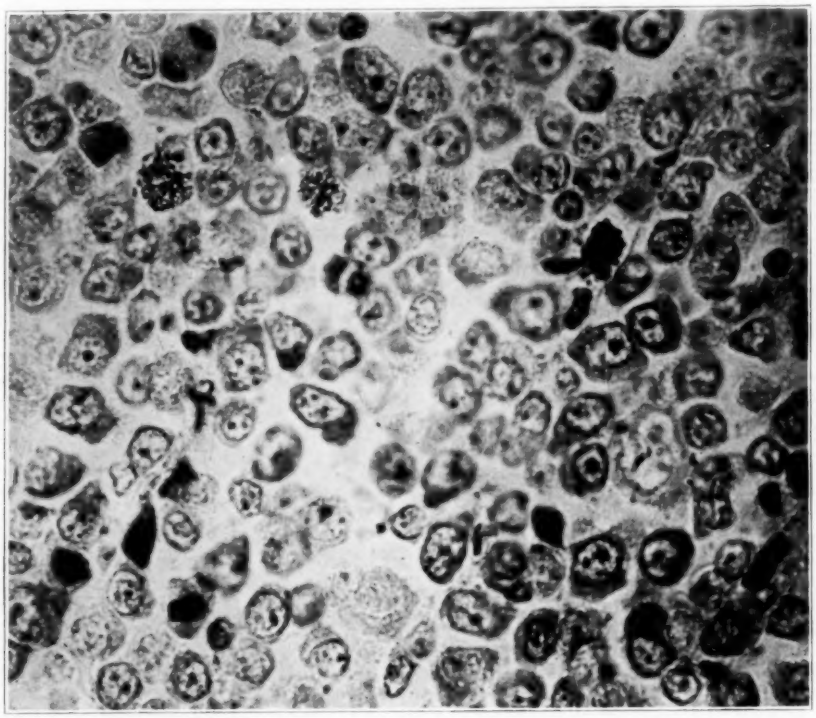

Fig. 1.—Section of femoral bone marrow, Giemsa stain; × 1,000. The heavily stained granular cells are eosinophils. The polygonal outlines of the tumor cells and their prominent nuclei may be noted.

8 by 4 by 4 cm. in extent, which was filled with fresh clots. The walls of this cavity were everywhere shot with small, fresh hemorrhagic areas, like bright red polka-dots. The left hemisphere presented a large area, 8 by 6 by 5 cm. in size, which was completely softened and felt cystic. It was located in the left parietal region, just posterior to the fissure of Rolando. Here the brain tissue had undergone marked softening and was yellow and granular in appearance, with a cyst at the center, which contained turbid, grayish fluid. The margins of the cyst were firm and definitely lobulated. This obviously represented an area of old hemorrhage, followed by absorption and degeneration. The ventricles were somewhat distended, the right containing a small quantity of bloody cerebro-

spinal fluid and some blood clots. The meninges, extending from the base and optic chiasm to the cervical cord, were infiltrated generally with hemorrhagic exudate, which also extended upward over the right hemisphere, particularly along the fissure of Sylvius and was marked over the posterior aspect of the cerebellar hemispheres as well. As a whole, the brain was markedly edematous, a large amount of slightly turbid fluid dripping from it.

When the dura was stripped away from the base of the middle fossa, a small, flat mass of apple green, lymphoid tissue was found nestling into the recess at the junction of the petrous and the squamous portion of the temporal bone (tegmen tympani). It measured about 1 cm. in diameter. The torcula contained a mass, which appeared to be a thrombus, rather firm and granular, with masses of greenish tissue at its periphery; otherwise the dural sinuses did not appear to be remarkable.

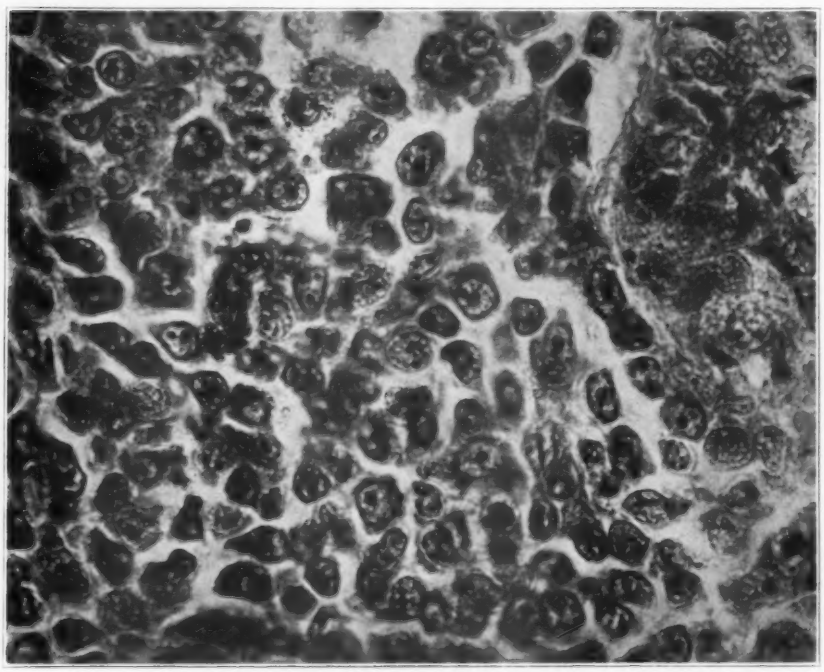

Fig. 2.—Section of testicular metastasis; a portion of a seminiferous tubule at one side; Giemsa's stain; × 1,000.

Microscopic Examination.—Tissue removed at necropsy was fixed in Zenker's fluid and in 4 per cent. liquor formaldehydi and stained with hematoxylin-eosin, eosin-methylene blue and by Giemsa's method, and special stains for oxydase granules were prepared by Graham's alphanaphthol-pyronin and McJunkin's benzidin methods. As the chief pathologic condition encountered in the various organs examined consisted of a tumor and its metastases, we shall consider this phase of the description first.

The tumor was most prominent in the bone marrow (Fig. 1) of the femur and in the testes (Fig. 2), about two thirds of which were replaced by tumor tissue. The cells of the growths showed a variable amount of cytoplasm. Some had but little, others a moderate amount. They measured from 3.75 microns to almost 10 microns in diameter, or if spherical or elongated, the long diameter

was about 10 microns, the cross diameter, 5 or 6 microns. The elongated forms were not seen frequently. The nuclei were vesicular, with a very delicate network in which chromatin masses, resembling two or more nucleoli, were suspended. The nuclear membrane was usually distinct; its outline varied from spherical, through ovoid, to reniform, or sometimes it was squash-shaped. The nuclei averaged from 3 to 4 microns in diameter. The cytoplasm varied with the stain used. In the hematoxylin-eosin stain, it appeared vaguely granular, or homogeneous, its color varying from red to deep purple. With Giemsa's stain, tiny neutrophil granules appeared in many cells. Sometimes a few, or many, eosinophil granules were demonstable (Figs. 1 and 2). The cytoplasm was violaceous and homogeneous. In methylene-blue sections, it varied from sky-blue to pink, and the granules were not so evident as in the Giemsa preparations, though they were more evident than in the hematoxylin. Some cells showed spherical masses of a material which stained deep red with eosin, in the Giemsa sections,

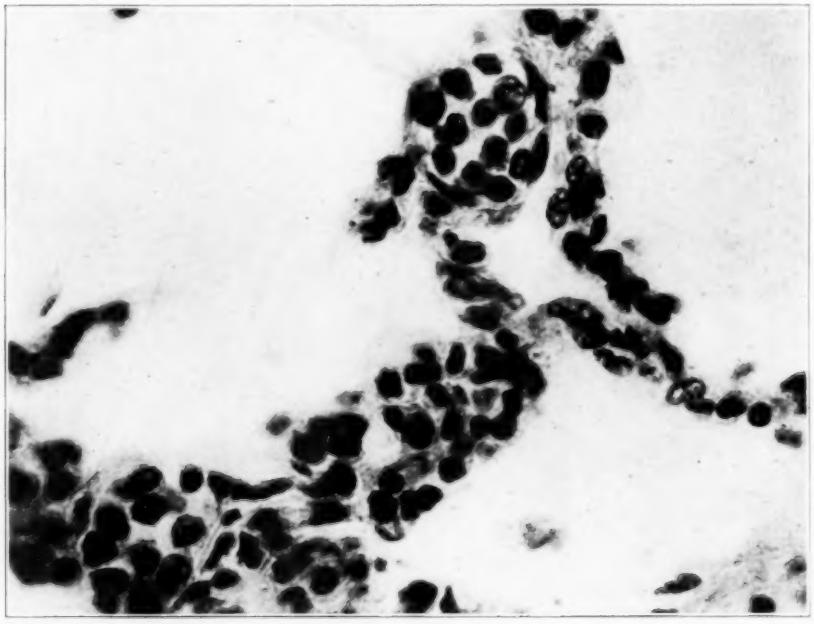

Fig. 3.—Capillary engorgement of pulmonary tissue, walls of alveoli; hematoxylin-eosin; × 800.

and appeared to be more or less homogeneous, although granules appeared in it when it was examined with green light. The outline of the cells as a whole was either spherical or ovoid and sometimes angular or polygonal. Oxydase granules were readily demonstrable in the cytoplasm by the Graham and McJunkin technics. The situation of these cells in the bone marrow, where innumerable mitoses were encountered, and the fact that the entire tissue was filled with them, their possession of many or few neutrophil granules and their dissemination in organs not particularly connected with the lymphatic apparatus would alone indicate their myelogenous origin. The positive oxydase reaction appeared to clinch the diagnosis. The bone marrow was unrecognizable as such in the femur, except for the presence of megakaryocytes; that of the ribs showed a subperiosteal zone of metastasis, the marrow of the more central portion being approximately normal. This is interesting in connection with

Askanazy's[1] observations. The testicular tubules were normal, but so wedged apart by tumor masses that some fields showed only two or three of them. Mitoses were less numerous in the metastases than in the bone marrow, which appeared to contain the primary tumor.

Some lymph nodes showed infiltration by the tumor, and some were wholly free from it. Several nodes were examined, and it was found that they were as often uninvolved as involved. The lymphoid centers in the nodules were quiescent, or sclerosed and "exhausted." There was no evidence of lymphoblastic activity, nor of myeloid metaplasia. If they contained any myelocytes, these were usually directly outside capillaries and probably migrated through their walls. A careful search was made for any such metaplastic centers as Roman describes, but without success.

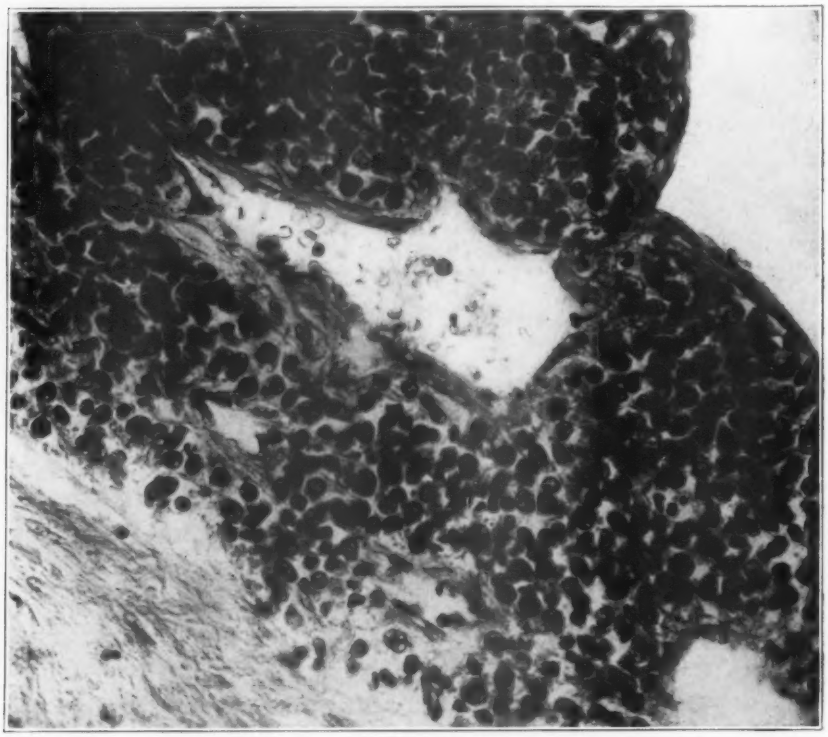

Fig. 4.—Dural metastasis, from wall of a sinus, hematoxylin-eosin; × 800.

The tonsils showed infiltration at the base, near the capsule, but the lymphoid apparatus was not directly involved.

There were small, focal metastases in the heart muscle, near vessels, but they were nowhere extensive.

The lungs showed thickening of the alveolar walls, and their vessels, from capillaries to large arteries, were filled almost completely with tumor cells (Fig. 3), very few erythrocytes being present (Compare Rowe and Hirschboeck[5]). The hemorrhages seen at necropsy were found microscopically.

The liver sections were practically negative.

The topography of the spleen was well maintained. The malpighian corpuscles were readily distinguished by their lymphoid tissue, the "germinal centers" of

which were reduced to mere masses of sclerosed reticulo-endothelium in which ameboid endothelial cells and much nuclear débris lay enmeshed. The surrounding lymphoid tissue showed no lymphoblastic activity. The sinuses were well defined; the walls were somewhat thickened and contained a moderate number of discrete tumor cells.

Aside from tumor metastases scattered along the pelvic submucosa and the course of some of the larger vessels, the kidney sections were not remarkable.

Sections of the dural sinuses and thrombi showed massive infiltration with tumor tissue, growing just beneath the intima (Fig. 4, compare Askanazy[1]).

Preparations from the margin of the cerebral hemorrhages showed these and, in addition, numerous tumor thrombi that blocked the smaller vessels in the brain tissue and undoubtedly caused the hemorrhages that killed the child, after bringing about hemiplegia. Often such thrombi were surrounded by extensive areas of red cells and necrosed cerebral tissue. The older hemorrhage showed the typical picture of necrosis and was filled with many endothelial phagocytes.

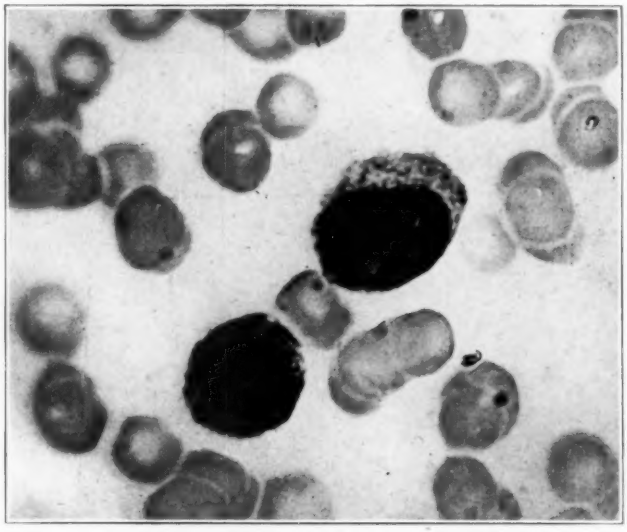

Fig. 5.—Myeloblast and polymorphonuclear from smear of Nov. 24, 1922. A few granules are present in the myeloblast; Wright's stain; × 1,200.

The anatomic diagnosis was: diffuse meningeal and deep cerebral hemorrhages, partial sinus thrombosis at torcula, cardiac dilatation, pulmonary hemorrhages, atrophy of thymus, tonsillar hypertrophy, and passive congestion of liver; chloroma, with metastasis to lymph nodes, tonsils, thymus, dura, cerebrum, pelvis of kidney, testis, urinary bladder and probable primary site in femoral bone marrow.

The microscopic diagnosis was myelogenous chloroma, with metastasis to the organs noted above.

Blood Examination.—As shown by Table 2, a number of smears were made during the child's stay in the hospital and stained by Wright's method. There were always a great many large cells, with a striking superficial resemblance to lymphoblasts. Granules could be discovered after a careful search with a good oil-immersion lens particularly in the early smears (Fig. 5), before the bone marrow had sacrificed quality to quantity, as it did later in the disease. The granules were usually neutrophil, sometimes the cells appeared to be myelo-

cytes with many small granules in a pinkish cytoplasm, more frequently they were myeloblasts with a few small granules of a pinkish cast in a bluish cytoplasm. A few basophilic myelocytes were found. Polymorphonuclear neutrophils were present in moderate numbers; eosinophils were very scarce, none being found in the average count. The lymphocytes were not remarkable. As the disease progressed, the myeloblastic type became almost the sole leukocyte in the field. These cells lay in groups of four or five (Fig. 6). They became less granular and more vacuolated, their nuclei becoming more diffusely and lightly stained. Apparently, the hematopoietic activity of the marrow had reached a point where the myeloblasts were being cast forth in a progressively less mature condition. The erythrocytes showed the changes usually seen in such conditions, poikilocytosis, anisocytosis, polychromatophilia and, as death approached, basophilia. Megaloblasts and normoblasts were present. The platelets were generally larger in size and fewer in number than under normal conditions.

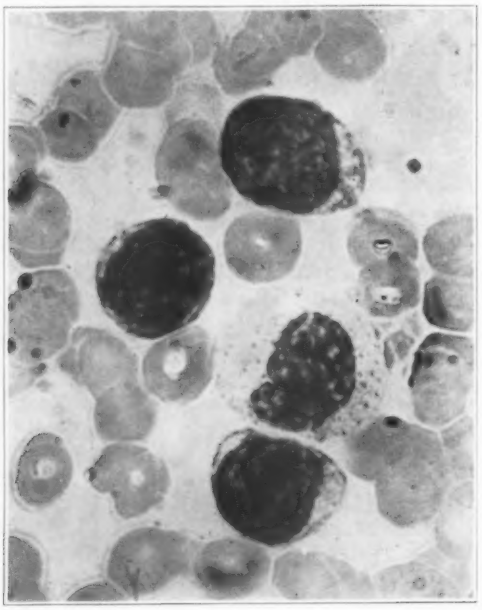

Fig. 6.—Three myeloblasts and a myelocyte from smear of Dec. 29, 1922; Wright's stain; × 1,200.

CONCLUSIONS

We have been unable to find any of Askanazy's crystalline substances in the tumor cells. The fact that he alone of a large number of investigators has found them is not particularly in favor of their being of any great diagnostic importance, or of constant occurrence. One cannot help believing that they may have been artefacts. Roman's myeloid metaplasia of the lymphatic "germinal centers" also stands unconfirmed. The presence of a few myeloid cells in this situation is no more significant than their appearance in the liver sinusoids, or the cellular spaces of connective tissue.

In closing, we must express our unwillingness to consider chloroma as an entity. It is merely a phase of a leukemia, in this case myelogenous in character. The term "chloroma" is useful as indicating the tendency of such leukemias to form green metastases to tumor tissue, as opposed to mere infiltration of the tissues with myelocytes or myeloblasts; just as one speaks of lymphosarcoma in contradistinction to a lymphatic leukemia. The name is also of use as a means of avoiding a more lengthy circumlocution; but that the condition differs materially from acute leukemia is far from clear. Askanazy's theory that most, if not all, cases of chloroma are of the myelogenous type is very interesting and should be checked carefully. As already mentioned, his reasons for this assumption appear to be logical. Careful Giemsa preparations and oxydase reactions performed in various ways will help materially in this process. In one of his papers, quoted by Rowe and Hirschboeck, Askanazy states that he can produce a green reaction with ordinary pus cells, when treated with ammonia and liquor formaldehydi. He cannot secure this reaction in sections of lymph nodes or other lymphoid tissue. It is clear that this experiment has influenced him in his decision as to the myelogenous character of chloroma, as well as the other points he advances in its favor. According to his experience, the oxydase reaction alone will not solve the problem, for he failed to obtain it in his case,[1] although controls carried out on leukocytes were positive. It may be that it would be well to perform the test, as we have done, by two or more technics, as it appears to be somewhat capricious.

THE SCHICK TEST PERFORMED ON MORE THAN 150,000 CHILDREN IN PUBLIC AND PAROCHIAL SCHOOLS IN NEW YORK (MANHATTAN AND THE BRONX) *

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Performance of the Schick test and active immunization with toxin-antitoxin were started on a large scale in the public schools of New York during the spring of 1921. Since then the work has been continued under the general direction of Dr. Park, and nearly all the children in public and parochial schools in Manhattan and the Bronx have been tested by myself and my group of assistants. In Brooklyn and Queens the work is being carried out by Dr. Schroder and her associates. The following report represents the tabulated summary of the Schick test on more than 150,000 schoolchildren in Manhattan and the Bronx.

A. THE SCHICK TEST AND CONTROL TEST: DILUTIONS FOR THE TEST

The Schick test was made on the right forearm of each child and the control test with heated toxin on the left forearm. The reactions were read from the third to the seventh day after the test, the day of reading depending on how the work could be arranged in the schools.

We consider the proper dilution of the toxin one of the most important elements in the accuracy of the test. When large numbers of children are to be tested, the use of unheated bulk toxin for the Schick test and of heated bulk toxin for the control is recommended [1] as the most accurate and economical method for carrying on the work. It is practically the only way to prepare a large amount of a *uniform* toxin dilution and to be certain of the accuracy of the results as regards one of the essential elements in the test. From an economical point of view this method is most important as we can apply the Schick test in this way to more than 3,000 children, and the expense for the material used will amount to less than one dollar. If proper precautions are taken in making these dilutions as recommended in a

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* Read before the Academy of Medicine, Toledo, Ohio, Jan. 15, 1923.

previous publication,[1] there will be no danger that dilutions that are too toxic will be prepared. Certainly, health officers, school physicians and general practitioners that have to test large numbers of children should be able to make the proper dilutions without the fear of any unnecessary risks.

B. SUSCEPTIBILITY TO DIPHTHERIA BY AGE PERIODS

In Table 1 and in the succeeding tables the percentages reported are significant in that they are based upon large numbers of tested individuals. Statistics regarding susceptibility and immunity to diphtheria and conclusions to which they lead should be founded on tests that are accurately carried out on many individuals. Conclusions based on a small number of tests are frequently liable to be misleading.

TABLE 1—*The Schick Test in the Public and Parochial Schools of New York (Manhattan and the Bronx)*

Age, Years	Total No. of Children Tested	Schick Positive Reactions	Schick Negative Reactions	Percentage of Schick Positive Reactions
5- 6	4,809	2,902	1,907	60.3
6- 7	13,754	6,944	6,810	50.4
7- 8	16,180	7,042	9,138	43.5
8- 9	17,126	6,278	10,848	36.6
9-10	18,065	5,825	12,240	32.2
10-11	18,057	5,308	12,749	29.3
11-12	17,994	5,075	12,919	28.2
12-13	16,258	4,327	11,931	26.6
13-14	14,138	3,271	10,867	23.1
14-15	9,650	1,906	7,744	19.7
15-16	4,861	869	3,992	17.8
16-17	389	68	301	18.4
Total	151,261	49,815	101,446	32.9

Table 1 gives a summary of the Schick tests carried out in the public and parochial schools in Manhattan and the Bronx. It shows the susceptibility by age periods of more than 150,000 children in a mixed population, as represented in the schools of New York. It is important to note that more than 60 per cent. of the children gave a positive Schick reaction upon entering school.

Table 2 shows the susceptibility to diphtheria of a large group of children between 6 and 12 months and between 1 and 14 years of age. In Group A are the children that were tested at the baby health stations. They represent a poorer class of the population. It is interesting to note that even in this group of the population there is a very high percentage of positive Schick reactions in children under 1 year, especially from 8 to 12 months of age. The susceptibility continues very high up to

1. Zingher, Abraham: The Schick Test: Standardization of Diphtheria Toxin for the Test and of Heated Diphtheria Toxin for the Control; Methods of Diluting the Toxin, J. A. M. A. **78**:490-493 (Feb. 18) 1922.

3 years of age. It is probable that even in the poorer classes of the population the very young children are kept fairly well separated, and exposure to repeated infection is thus to a certain extent avoided. The percentage of positive reactions diminishes very rapidly after the age of 7 years.

TABLE 2.—*Group A: The Schick Test in Baby Health Stations and Play Grounds (Manhattan and the Bronx)*

Age	Total No. of Children Tested	Schick Positive Reactions	Schick Negative Reactions	Percentage of Schick Positive Reactions
6- 7 months	53	30	23	56.6
7- 8 months	41	26	15	63.4
8- 9 months	62	52	10	83.8
9-10 months	58	54	4	93.1
10-11 months	61	53	8	87.0
11-12 months	34	31	3	91.1
1- 3 years	1,727	1,438	289	83.2
4- 6 years	1,328	779	549	59.6
7-10 years	903	330	573	36.5
11-14 years	235	53	182	22.5
Total	4 502	2,846	1,656	63.2

Group B: The Schick Test in Public School Children of Kindergarten and 1A Classes

5- 6 years	327	253	64	77.15
6- 7 years	933	632	301	67.73
Total	1,260	885	365	70.25

TABLE 3.—*Results of Schick Test at Public School 52 (Manhattan)*

Age	Total No. of Children Tested	Schick Positive Reactions	Schick Negative Reactions	Percentage of Schick Positive Reactions
5- 6 years	19	16	3	84.21
6- 7 years	69	57	12	82.61
7- 8 years	114	86	31	72.81
8- 9 years	91	69	22	76.26
9-10 years	83	59	24	71.09
10-11 years	60	35	25	58.33
11-12 years	64	44	20	68.75
12-13 years	46	31	15	67.39
13-14 years	42	22	20	52.38
14-15 years	18	11	7	61.11
15-16 years	10	5	5	50.00
Total	616	432	184	70.13

In Group B the table gives by contrast the results in a series of twelve schools in which more than 77 per cent. of the children between 5 and 6 years of age had shown a positive reaction. These schools are located in the less congested sections of the city and attended by children of the more well-to-do. In this group are included a few schools in which from 85 to 90 per cent. of the children in the kindergarten and 1 A classes gave a positive Schick reaction. Table 3 gives the findings in one of these schools.

These figures emphasize the high proportion of susceptible children on admission to school and should be remembered in connection with the practical work of immunizing them against diphtheria. When too many difficulties are in the way of giving the preliminary Schick test to these young children the test could be omitted and the children simply injected with the three doses of toxin-antitoxin.

Table 4 gives the results of a more detailed study of the Schick tests on 60,100 children, which represent a part of the tests in Table 1. In this table the reactions are classified [2] as positive and positive-combined among the nonimmunes, and as negative and negative-pseudo among the immunes. The table brings out the following two interesting and important facts:

1. A considerable number of children of school age show negative-pseudo reactions. These reactions should be identified with accuracy by means of the control test.[3] The mistake will thus be avoided of interpreting them as positive Schick reactions with the resulting error of giving the children unnecessarily the injections of toxin-antitoxin. It is in this very group that the toxin-antitoxin produces the most marked local and constitutional symptoms.

2. The negative-pseudo reactions were more than two and one-half times as frequent among the immunes as the positive-combined reactions among the nonimmunes. This is additional evidence that exposure to infection with the diphtheria bacillus is an important factor in the development of the so-called "natural" antitoxic immunity. Such exposure produces not only an antitoxic immunity, but also seems to sensitize many individuals to the protein substance of the diphtheria bacillus. This sensitization appears in the form of negative-pseudo reactions in the Schick test and control test.

Table 5 gives in the last three percentage columns a comparison in age susceptibility between the children in three different groups of schools. Group I represents twelve schools in which the positive Schick reactions varied from 67 to 40 per cent.; Group II, ten schools with positive reactions from 40 to 30 per cent., and Group III, twenty-two schools with positive reactions from 30 to 13 per cent. The differences in these three groups show that the contrast in susceptibility is less definite in early school life than in later school life. The "natural" immunity to diphtheria among the children in the crowded and poorer districts increases more rapidly with advancing school years than among those of the more well-to-do.

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2. Zingher, Abraham: Diphtheria Prevention Work in the Public Schools of New York City, J. A. M. A. **77**:835-841 (Sept. 10) 1922.

3. Zingher, Abraham: Methods of Using Diphtheria Toxin in the Schick Test and of Controlling the Reaction, Am. J. Dis. Child. **11**:269 (April) 1916.

TABLE 4.—*The Schick Test in the Public Schools of New York (Manhattan and the Bronx): Susceptibility to Diphtheria by Ages*

Age, Years	Total Tested	Nonimmune			Immune			Percentage of Nonimmune			Percentage of Immune		
		Schick Positive Reactions	Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Negative-Pseudo Reactions	Total Schick Negative Reactions	Of Total Tested	Percentage of Positive-Combined Reactions		Of Total Tested	Percentage of Negative-Pseudo Reactions	
									Of Total Tested	Of Total Schick Positive		Of Total Tested	Of Total Schick Negative
4– 5	30	21	0	21	8	1	9	70.0	0.0	0.0	30.0	3.0	11.0
5– 6	1,575	975	21	996	508	71	579	63.2	1.3	2.0	36.7	4.0	12.0
6– 7	5,377	2,586	61	2,647	2,393	337	2,730	49.2	1.0	2.0	50.8	6.0	12.0
7– 8	6,130	2,525	112	2,637	3,010	483	3,494	43.0	2.0	4.0	57.0	8.0	14.0
8– 9	6,539	2,176	187	2,363	3,484	692	4,176	36.1	2.8	8.0	63.9	10.0	16.0
9–10	7,071	2,029	125	2,224	3,802	1,045	4,847	31.4	2.7	9.0	68.6	14.0	21.0
10–11	7,205	1,867	197	2,064	3,997	1,164	5,141	28.6	2.7	9.0	71.4	16.0	22.0
11–12	7,344	1,901	222	2,123	4,063	1,158	5,221	28.9	3.0	10.0	71.1	16.0	22.0
12–13	6,405	1,608	212	1,820	3,748	837	4,585	28.4	3.0	11.0	71.6	13.0	18.0
13–14	6,252	1,188	227	1,415	3,466	1,371	4,837	22.6	3.0	16.0	77.4	22.0	28.0
14–15	4,147	669	123	792	2,520	832	3,352	19.1	3.0	15.0	80.9	20.0	25.0
15–16	1,760	270	50	320	1,068	372	1,440	18.1	3.0	16.0	81.9	21.0	26.0
16–17	247	38	11	49	154	44	198	19.8	4.0	23.0	80.1	18.0	22.0
17–18	18	2	0	2	14	2	16	11.1	0.0	0.0	88.9	11.0	12.0
Total	60,100	17,855	1,618	19,473	32,235	8,409	40,624	32.6	2.7	8.3	67.4	14.0	20.7

TABLE 5.—*Susceptibility to Diphtheria by Ages in the Public Schools of New York (Manhattan and the Bronx) Classified by School Group*

Age, Years	Group I		Group II		Group III		Percentage of Schick Positive Reactions		
	Twelve Schools Schick Positive 67-40 per Cent.		Ten Schools Schick Positive 40-30 per Cent.		Twenty-two Schools Schick Positive 30-13 per Cent.				
	Total Tested	Schick Positive Reactions	Total Tested	Schick Negative Reactions	Total Tested	Schick Positive Reactions	Group I	Group II	Group III
4– 5	6	6	9	6	15	9	100.0	66.6	60.0
5– 6	376	283	257	153	723	337	75.2	59.5	46.6
6– 7	1,142	775	992	501	2,276	840	67.8	50.5	32.5
7– 8	1,315	782	1,246	531	2,709	878	51.1	42.6	32.4
8– 9	1,390	774	1,331	500	3,090	788	55.6	37.6	25.5
9–10	1,382	669	1,473	521	3,507	801	48.4	35.5	22.8
10–11	1,276	563	1,340	461	3,851	816	44.1	34.4	21.1
11–12	1,348	633	1,380	485	3,905	782	46.9	35.1	20.0
12–13	1,164	471	1,267	377	3,700	744	40.4	29.7	19.8
13–14	906	354	1,067	284	3,415	571	38.3	26.6	16.6
14–15	665	201	730	193	2,285	266	30.2	26.4	11.6
15–16	312	87	295	74	947	113	27.9	25.1	11.9
16–17	73	27	35	5	136	17	37.0	14.3	12.5
Total	11,415	5,625	11,422	4,091	30,619	6,962	49.2	35.8	22.7

C. SUSCEPTIBILITY TO DIPHTHERIA INFLUENCED BY SOCIAL AND RACIAL FACTORS

In the following four tables the schools are arranged in the order in which the children showed positive Schick reactions, the schools with the highest percentage appearing first.

Tables 6 and 7 give the results obtained in a series of individual public schools in the borough of Manhattan. Table 6 shows schools with positive Schick reactions varying from 70 to 30 per cent. Many of these schools are located in better sections of the city and attended

TABLE 6.—*The Schick Test in the Public Schools of Manhattan, New York*

Public School	Location	Nonimmunes			Immunes			Total Tested	Per Cent. Schick Positive Reactions
		Schick Positive Reactions	Schick Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Schick Negative-Pseudo Reactions	Total Schick Negative Reactions		
52	Broadway and Academy St..	395	37	432	126	58	184	616	70.13
9	82d St. and West End Ave....	161	13	174	91	34	125	299	58.53
6	Madison Ave. and 85th St....	180	15	195	113	29	142	337	57.86
165	108th St. and Amsterdam Ave.	295	10	305	158	70	228	533	57.22
166	89th St. near Columbus Ave..	157	8	165	92	41	133	298	55.36
115	177th St. and St. Nicholas Ave.	327	29	356	188	132	320	676	52.66
93	Amsterdam Ave. and 93d St..	287	22	309	185	105	290	599	51.59
10*	St. Nicholas Ave. and 117th St.	329	17	346	244	95	339	685	50.51
94	Amsterdam Ave. and 68th St.	316	20	336	369	77	446	782	42.96
179	102d St. and Amsterdam Ave.	227	10	237	317	22	339	576	41.14
56	18th St. and 9th Ave.....	202	23	225	271	51	322	547	41.13
87	77th St. and Amsterdam Ave.	156	9	165	213	29	242	407	40.54
50	20th St. and 3d Ave.....	145	16	161	249	19	268	429	37.52
63	4th St. and 1st Ave.....	383	44	427	672	88	760	1,187	35.96
51	44th St. and 10th Ave.....	289	23	312	525	53	578	890	35.05
170*	111th St. and Lenox Ave.....	143	10	153	236	52	288	441	34.69
190	82d St. and 2d Ave.....	196	5	201	362	25	387	588	34.18
18	51st St. and Lexington Ave..	125	2	127	226	20	246	373	34.00
141	58th St. and 9th Ave.....	183	9	192	328	53	381	573	33.51
28	40th St. and 8th Ave.....	200	9	209	374	51	425	634	32.96
73	46th St. and 3d Ave.....	157	0	157	300	29	329	486	32.29
36	9th St. and Avenue C.....	208	7	215	422	32	454	669	32.15
86	Lexington Ave. and 96th St..	320	25	345	539	200	739	1,084	31.83
10†	St. Nicholas Ave. and 117th St.	155	13	168	253	108	361	529	31.76
71	7th St. and Avenue B.....	168	46	214	367	94	461	675	31.70
13	E. Houston and Essex Sts...	310	16	326	671	32	703	1,029	31.63
65	Eldridge and Hester Sts.....	423	5	428	885	39	934	1,352	31.66

* Primary. † Boys.

by children of a more well-to-do class than those enumerated in Table 7 in which the schools show positive reactions varying from 30 to 14 per cent. It is interesting to note that of sixty-eight schools in the borough of Manhattan there are twenty-seven schools in the group of higher percentages as compared with the forty-one schools in the group of lower percentages.

Table 8 presents the results of tests in the public schools in the borough of the Bronx. In twenty-nine of these public schools the children gave positive Schick reactions varying from 63 to 32 per cent. and in only four schools from 28 to 17 per cent.

A similar contrast in the susceptibility of school children is found by comparing the parochial schools of Manhattan with those in the Bronx, as seen in Table 9.

These tables illustrate the well-known fact that in the more recently developed borough of the Bronx there are fewer sections associated with congestion and crowding of the population than in the older borough of Manhattan.

TABLE 7.—*The Schick Test in the Public Schools of Manhattan, New York*

Public School	Location	Nonimmunes			Immunes			Total Tested	Per Cent. Schick Positive Reactions
		Schick Positive Reactions	Schick Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Schick Negative-Pseudo Reactions	Total Schick Negative Reactions		
122	9th St. and 1st Ave.	333	10	343	765	39	804	1,147	29.90
58	52d St. and 8th Ave.	130	9	139	320	9	329	468	29.70
76	Lexington Ave. and 68th St.	135	8	143	283	61	344	487	29.36
79	1st St. and 1st Ave.	191	11	202	455	34	489	691	29.23
105	E. 4th St. and Avenue B.	108	12	120	266	32	298	418	28.70
135	1st Ave. and 51st St.	206	209	235	396	192	587	822	28.52
32	35th St. and 9th Ave.	167	16	183	391	74	465	648	28.24
170*	111th St. and Lenox Axe.	156	19	175	310	135	445	620	28.23
184	116th St. and Lenox Ave.	477	52	529	1,001	348	1,349	1,878	28.17
4	Rivington and Ridge Sts.	162	27	189	446	40	486	675	28.00
137	Grand and Essex Sts.	168	5	173	429	26	455	628	27.54
88	Rivington and Lewis Sts.	187	18	205	504	48	552	757	27.08
151	1st Ave. and 91st St.	149	25	174	373	96	469	643	27.06
27	41st St. and 3d Ave.	209	23	232	499	134	633	865	26.82
22	Stanton and Sheriff Sts.	262	15	277	737	21	758	1,035	26.76
31	Monroe and Gouverneur St.	237	34	271	655	104	759	1,030	26.31
150	96th St. and 2d Ave.	257	12	269	667	93	760	1,029	26.14
59	57th St. and 3d Ave.	193	18	211	439	158	597	808	26.11
160	Rivington and Suffolk Sts.	223	15	238	646	28	674	912	26.09
110	Broome and Cannon Sts.	159	13	172	424	65	489	661	26.02
92	Broome and Ridge Sts.	233	13	246	636	88	724	970	25.36
25	5th St. and 1st Ave.	339	16	355	885	161	1,046	1,401	25.34
12	Madison and Jackson Sts.	302	52	354	865	175	1,040	3,194	25.32
38	Broome and Clark Sts.	120	5	125	334	35	369	494	25.30
91	Stanton and Forsyth Sts.	272	49	321	773	206	979	1,300	24.69
82	1st Ave. and 70th St.	100	11	111	266	74	340	451	24.61
40	20th St. and 1st Ave.	56	8	64	167	30	197	261	24.52
70	75th St. and 3d Ave.	159	15	174	472	88	552	726	23.97
104	16th St. and 1st Ave.	158	32	190	468	169	637	827	22.97
121	102d St. and 3d Ave.	215	25	240	552	274	826	1,066	22.51
140	Norfolk and Rivington Sts.	122	4	126	410	24	434	560	22.50
1	Henry and Oliver Sts.	257	28	285	930	68	998	1,283	22.20
35	Chrystie and Delancy Sts.	176	9	185	630	49	679	864	21.41
114	Oak and James Sts.	232	23	255	915	37	952	1,207	21.11
147	E. B'way and Gouverneur St.	196	17	213	735	129	864	1,077	19.71
74	63d St. and 3d Ave.	199	29	228	739	224	963	1,191	19.14
109	99th St. and 2d Ave.	221	31	252	918	196	1,114	1,366	18.45
21	Mott and Elizabeth Sts.	315	16	331	1,415	104	1,519	1,850	17.88
97	Mangin and Stanton Sts.	107	6	113	504	61	565	678	16.66
34	Broome and Sheriff Sts.	75	4	79	364	31	395	474	16.66
23	Mulberry and Bayard Sts.	126	25	151	756	126	882	1,033	14.62

* Girls.

The racial factor may also be noted in these tables. The schools in which there is the highest percentage of positive Schick reactions are attended largely by native born children of American parents. The schools showing the lowest percentage of positive Schick reactions are those attended to a great extent by children of Italian parents. The other schools with percentages varying between these extremes are attended by children of more recently immigrated Jewish, Russian,

TABLE 8.—*The Schick Test in the Public Schools of the Bronx, New York*

Public School	Location	Nonimmunes			Immunes			Total Tested	Per Cent. Schick Positive Reactions
		Schick Positive Reactions	Schick Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Schick Negative-Pseudo Reactions	Total Schick Negative Reactions		
26	Andrews and Burnside Aves..	206	4	210	110	12	122	332	63.25
46	196th St. and Driggs Ave.....	248	13	261	122	32	154	415	62.90
33	Jerome and Walton Aves....	214	11	225	87	47	134	359	62.67
35	163d St. and Grant Ave.....	338	12	350	188	24	212	562	62.27
28	Tremont and Anthony Aves.	271	18	289	166	47	213	302	57.57
6	Tremont and Vyse Aves.....	548	7	555	377	45	422	977	56.81
48	Coster and Faile Sts.....	447	11	458	374	54	428	886	51.69
44	Prospect Ave. and 176th St...	288	78	366	202	145	347	713	51.33
25	149th St. and Union Ave.....	392	57	449	354	131	485	934	43.00
53	E 168th St. and Findlay Ave.	410	22	432	370	127	497	929	46.50
2	3d Ave. and 169th St.....	273	15	388	410	47	457	845	45.92
59	Bathgate Ave. and 182d St...	254	16	270	259	61	320	590	45.76
10	Eagle Ave. and 163d St.....	348	40	388	335	125	460	848	45.70
57	180th St. and Belmont Ave...	486	34	520	476	142	618	1,138	45.69
20	Fox and 167th Sts.....	365	31	396	347	135	482	878	45.10
23	165th St. and Tinton Ave.....	358	12	370	392	73	465	835	44.31
39	Longwood and Kelly Sts.....	278	28	306	248	172	420	726	42.15
50	Bryant Ave. and 172d St.....	458	47	505	462	322	784	1,289	39.18
30	141st St. and Brook Ave.....	241	64	305	292	214	506	811	37.61
37	145th St. and Willis Ave.....	236	28	264	285	158	443	707	37.34
5	Webster Ave. and 189th St...	161	19	180	284	106	290	489	36.80
27	St Anns Ave. and 147th St...	359	65	424	412	385	797	1,221	34.70
51	158th St. and Jackson Ave...	262	25	287	387	156	543	830	34.58
32	183d St. and Beaumont Ave..	622	19	641	1,070	148	1,218	1,859	34.48
29	Cypress Ave. and 135th St....	314	54	368	427	285	712	1,080	34.07
55	St. Pauls Pl. and Wash. Ave.	416	40	456	712	230	942	1,398	32 62
9	138th St. and Brook Ave.....	257	28	285	484	120	604	889	32.06
45	189th and Hoffman Sts.....	521	20	541	1,221	133	1,354	1,895	28.55
31	Mott Ave. and 144th St.....	136	7	143	429	42	471	614	23.30
4	Fulton Ave. and 173d St.....	193	55	248	462	423	885	1,133	21.60
1	Colledge Ave. and 145th St...	85	17	102	309	180	489	591	17.25

TABLE 9.—*The Schick Test in Parochial Schools in Manhattan and the Bronx, New York*

School and Location	Schick Positive Reactions	Schick Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Schick Negative-Pseudo Reactions	Total Schick Negative Reactions	Total Tested	Per Cent. Schick Positive Reactions
St. Thomas Aquinas, 1915 Daley Ave., Bronx	156	2	158	109	18	127	285	54.73
St. Augustine, 167th St. and Fulton Ave., Bronx	143	2	145	190	14	204	349	41.50
St. Jerome, 137th St. and Alexander Ave., Bronx	102	2	104	139	31	170	274	39.75
Cathedral, 50th St. and Lexington Ave., Manhattan	90	8	98	138	54	192	290	33.79
St. Gabriel, 36th St. and 8th Ave., Manhattan	163	3	166	328	38	366	532	31.20
St. John the Evangelist, 50th St and 1st Ave., Manhattan	87	14	101	162	74	236	337	29.94
St. Monica, 80th St. and 1st Ave., Manhattan	91	26	117	165	113	278	395	29.60
St. Bernard (Girls), 13th St. and 9th Ave., Manhattan	102	27	129	184	126	310	439	29.30
St. Stephen, 28th St. and Lexington Ave., Manhattan	69	6	75	169	20	189	264	28.40
Sacred Heart, 51st St. and 10th Ave., Manhattan	209	8	217	433	119	552	769	28.22
Resurrection, 151st St. and 8th Ave., Manhattan	66	3	69	155	34	189	258	26.66
Immaculate Conception, 14th St. and Avenue A, Manhattan	83	2	85	247	46	293	378	22.49
St. Bernard (Boys), 13th St. and 9th Ave., Manhattan	75	12	87	224	91	315	402	21.11
St. Anthony, 62 Macdougal St., Manhattan	62	0	62	240	4	244	306	20.26
St. Patrick (Girls), 233 Mott St., Manhattan	176	3	179	642	48	790	969	18.50
St. Patrick (Boys), 268 Mulberry St., Manhattan	51	1	52	333	7	340	392	13.28

Polish, Czechoslovacian, Irish parents, etc., one or two of these nationalities frequently predominating in some of the schools. Table 9 giving the percentage of positive Schick reactions among children in parochial schools is also interesting in showing that overcrowding and repeated exposure to infection are really more important than race as factors in natural immunity to diphtheria. The three schools in the Bronx in which the children gave the highest percentage of positive Schick reactions are attended largely by children of Irish extraction. On the other hand, some of the schools in Manhattan which show a very low percentage of positive reactions, as for instance St. Bernard's, are also attended mostly by children of Irish parentage. It is significant to note that the school with the lowest percentage of positive Schick

TABLE 10.—*The Schick Test in the Public School of Metuchen, N. J.; Caldwell, N. J.; Verona, N. J., and Cedar Grove, N. J.*

Age, Years	Nonimmune			Immune			Total Tested	Percentage of Schick Positive Reactions
	Schick Positive Reactions	Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Negative Pseudo Reactions	Total Schick Negative Reactions		
5- 6	62	0	62	7	0	7	69	89.8
6- 7	73	0	73	11	1	12	85	85.8
7- 8	82	0	82	13	1	14	96	85.4
8- 9	93	0	93	22	2	24	117	79.5
9-10	75	0	75	24	2	26	101	74.2
10-11	61	0	61	21	9	30	91	67.0
11-12	74	1	75	19	4	23	98	76.5
12-13	62	2	64	20	4	24	88	72.7
13-14	64	2	66	17	7	24	90	73.3
14-15	22	1	23	11	2	13	36	63.9
15-16	41	2	43	10	4	14	57	75.4
16-17	39	1	40	11	5	16	56	71.4
Total	748	9	757	186	41	227	984	76.9

reactions, St. Patrick's, is located in the most congested section of the city, in which the population is nearly all Italian.

The results stated in these tables correspond closely to those that were reported in a previous communication [2] in a series of forty-four schools in Manhattan and the Bronx.

Table 10 shows the very high percentage of positive Schick reactions in public schools located in small suburban towns, attended to a large extent by children of a more well-to-do class. Many of those that gave negative reactions were children of foreign parents recently settled in town.

Table 11 gives the results of the Schick test in four public schools located in Union Hill, N. J. The schoolchildren can be divided fairly evenly into two groups, those of American born and those of foreign born parents. Among the latter we found a much higher proportion of negative Schick reactors.

D. SUSCEPTIBILITY TO DIPHTHERIA BY SEX

In our previous work with the Schick test, covering a period of more than nine years, we have generally found a larger number of positive reactions among females than among males.

Table 12 shows a definitely higher percentage of positive Schick reactions among girls than among boys. Among the girls there is also a higher proportion of negative-pseudo and positive-combined reactions.

TABLE 11.—*The Schick Test in the Public Schools of Union Hill, N. J.*

Age, Years	Schick Positive Reactions	Schick Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Schick Negative-Pseudo Reactions	Total Schick Negative Reactions	Total Tested	Percentage of Schick Positive Reactions
5- 6	46	0	46	22	1	23	69	66.66
6- 7	49	1	50	42	3	45	95	52.63
7- 8	59	4	63	60	9	69	132	47.72
8- 9	55	5	60	55	14	69	129	46.51
9-10	44	5	49	62	22	84	133	36.84
10-11	43	6	49	59	30	89	138	35.50
11-12	40	5	45	63	31	94	139	32.37
12-13	35	7	42	73	30	103	145	29.00
13-14	56	9	65	77	53	130	195	33.33
14-15	46	10	56	46	30	76	132	42.42
15-16	14	7	21	24	11	35	56	37.50
16-17	6	0	6	6	2	8	14	42.85
Total	498	59	552	589	236	825	1,377	40.00

TABLE 12.—*Comparison of Susceptibility to Diphtheria Between Boys and Girls in New York Public Schools (Public Schools 188, 39, 83, 159, Manhattan)*

Age, Years	Boys		Girls		Percentage of Schick Positive Reactions		Percentage of Negative-Pseudo Reactions of Immunes		Percentage of Positive-Combined Reactions of Nonimmunes	
	Total	Schick Positive Reactions	Total	Schick Positive Reactions	Boys	Girls	Boys	Girls	Boys	Girls
5- 6	74	35	60	27	46.0	45.0	17.5	21.2	0	0
6- 7	195	74	207	84	37.8	40.6	8.2	24.4	4.1	1.0
7- 8	248	83	244	93	33.4	38.1	11.5	23.2	3.6	5.3
8- 9	277	76	219	68	27.4	31.5	15.0	22.2	5.2	11.8
9-10	398	86	281	82	21.9	39.2	21.5	30.6	7.0	15.8
10-11	675	147	264	62	21.8	23.4	24.2	38.1	12.7	16.1
11-12	782	153	290	72	19.5	24.1	26.8	31.7	16.3	15.3
12-13	783	116	479	99	14.8	20.7	26.5	36.0	14.6	21.2
13-14	740	91	497	100	12.3	20.1	26.6	35.7	19.7	23.0
14-15	500	65	361	67	13.0	21.3	27.6	29.5	23.1	19.4
15-16	224	17	155	21	7.5	13.4	18.3	36.5	0.0	23.3
16-17	31	2	21	3	6.4	14.3	27.6	33.3	0.0	33.3
Total	4,922	945	3,087	778	19.2	25.3	23.7	32.3	11.9	14.2

In Table 13 are given the results of the Schick test on more than 6,000 adult inmates of an insane asylum. The table brings out the fact that even among those who are far advanced in years there is a definite though small percentage of positive Schick reactors. It shows that repeated exposure even over a long period of years does not produce an antitoxic immunity in certain individuals. These figures help to explain why it is difficult to develop an active immunity in a small

percentage of individuals even with several series of toxin-antitoxin injections. There is a partial or nearly total inability of the tissues in some people to respond to the immunizing effects of certain antigens. This resistance is probably hereditary in character.

The table also shows a higher percentage of positive Schick reactions among adult females than among males.

E. "NATURAL" IMMUNITY TO DIPHTHERIA

In the preceding tables we have seen some of the important factors active in the development of spontaneous immunity to an endemic infectious disease. These factors consist of crowding and repeated

TABLE 13.—*The Schick Reaction in Advanced Age Groups (Manhattan State Hospital)*

Age, Years	Schick Positive Reactions	Schick Positive-Combined Reactions	Total Schick Positive Reactions	Schick Negative Reactions	Schick Negative-Pseudo Reactions	Total Schick Negative Reactions	Total Tested	Percentage of Schick Positive Reactions
Males—								
10-20	12	1	13	57	18	75	88	14.7
20-30	47	8	55	551	99	650	705	7.8
30-40	45	11	56	580	110	690	746	7.5
40-50	28	2	30	418	69	487	517	5.8
50-60	21	1	22	292	20	312	334	6.5
60-70	5	0	5	142	4	146	151	3.3
Over 70	2	0	2	59	1	60	62	3.2
Total	160	23	183	2,099	321	2,420	2,603	7.0
Females—								
10-20	9	2	11	60	9	69	80	13.7
20-30	76	15	91	376	81	457	548	16.6
30-40	89	13	102	514	126	640	742	13.7
40-50	58	12	70	546	87	633	703	9.9
50-60	34	3	37	466	83	549	586	6.3
60-70	30	1	31	446	34	480	511	6.6
Over 70	8	0	8	107	4	111	119	6.7
Total	304	46	350	2,515	424	2,939	3,289	10.0

exposure to infections with the diphtheria bacillus. In cities this organism is constantly present. From 2 to 3 per cent. of the inhabitants are carriers of virulent diphtheria bacilli. The high percentage of positive Schick reactions among the children of the more well-to-do and the low percentage among those of the poorer classes show the importance of overcrowding in the development of immunity. In the smaller communities and especially in rural sections where the people live more or less segregated, the percentage of positive Schick reactions is very high. In rural schools we have seen from 85 to 90 per cent. of positive Schick reactions. This is true not only for children but also for adults. In various city hospitals we have tested groups of nurses, many of whom had only recently come to the city from smaller communities, and have found that among them from 50 to 75 per cent. gave a positive reaction to the Schick test. Similar observations were reported

to me in a personal communication by Dr. Charles W. Kidder, District Health Officer of Woodstock, Vermont. He gave the Schick test to 2,030 children and found in rural towns, with a very high percentage of native born children, as high as 96 per cent. of positive reactors. In the larger villages on the railroad and in villages containing a large percentage of foreign population, he obtained correspondingly fewer positive Schick reactors, the lowest percentage being 60. Of eighty-seven teachers between the ages of 20 and 60 years, 82 per cent. gave a positive reaction.

Table 14 is an interesting study of the effect of close contact in an institution. It gives the results of the Schick test in an institution in

TABLE 14.—*The Schick Test at St. Agatha's Home, Nanuet, N. Y.*

Age, Years	Institution Children						Preventorium Children (Less Than Three Months in the Institution)			
	Total Tested	Schick Negative Reactions	Negative-Pseudo Reactions	Total Immune	Schick Positive Reactions	Percentage of Schick Positive Reactions	Total Tested	Schick Negative Reactions	Schick Positive Reactions	Percentage of Schick Positive Reactions
2– 3.....	8	4	0	4	4	50.0	0	0	0	0
3– 4.....	13	8	0	8	5	38.5	0	0	0	0
4– 5.....	21	16	0	16	5	23.8	6	2	4	66.6
5– 6.....	22	15	1	16	6	27.3	6	4	2	33.3
6– 7.....	53	42	2	44	9	17.0	7	4	3	43.0
7– 8.....	36	25	6	31	5	13.9	16	9	7	43.7
8– 9.....	44	35	7	42	2	4.6	9	6	2	33.3
9–10.....	54	44	8	52	2	3.8	11	10	1	9.0
10–11.....	63	59	3	62	1	1.6	9	6	3	33.3
11–12.....	59	46	10	56	3	5.0	8	6	2	25.0
12–13.....	67	51	13	64	3	4.5	2	1	1	50.0
13–14.....	50	37	9	46	4	8.0	3	3	0	0.0
14–15.....	38	30	6	36	2	5.3	1	1	0	0.0
15–16.....	15	11	4	15	0	0.0	0	0	0	0.0
Total.....	543	423	69	492	51	9.4	78	52	26	33.3
Total*.....	520	...	...	492	28†	5.4	...	...	...	33.3

* Excluding twenty-three children giving a positive reaction who had been less than three months in the institution.

† Of the twenty-eight children giving a positive reaction, twenty had been in the institution between three months and two years.

which most of the children came from New York City. Under "Institution" children are included those that have been at the institution three months or longer; under "Preventorium" children those who have been there less than three months.

Among the "Preventorium" children, twenty-six of a total of seventy-eight, or 33.3 per cent., gave a positive Schick reaction. This is in striking contrast to the "Institution" children of whom only twenty-eight of a total of 520, or 5.4 per cent., gave positive reactions. Even among the twenty-eight positively reacting "Institution" children, fully twenty had been in the institution only from three months to two years. Frequent contact in the institution explains these results.

Dudley [4] has recently reported the results of the Schick test in an institution in which diphtheria had been prevalent and had resulted in a large number of carriers. This study furnishes additional evidence that exposure to infection with the diphtheria bacillus is an important factor in the development of contact or so-called "natural" immunity.

Without going too far astray one could probably generalize from "natural" immunity against diphtheria to "natural" immunity against some of the other infectious diseases. Such immunity is seen in a large group of city born and city bred people who have never had these infections. Russell has drawn our attention to the fact that, during the recent war, epidemics of infectious diseases swept, as a rule, through camps in which the soldiers were recruited from the smaller towns and villages and from rural sections of the states. Many city children are often found to be relatively immune to some of these infectious diseases although they give no history of having had the infections. Herrman's [5] observations on immunity to measles also bear on this point. It has, of course, been often assumed that repeated exposure to infectious diseases, or to the carriers of their viruses or bacteria, is the chief factor in "natural" immunity; but so far it is only in diphtheria that we have been able to demonstrate this with any degree of scientific accuracy.

SUMMARY AND CONCLUSIONS

1. More than 150,000 children have been given the Schick test during the last two years in the public and parochial schools of the boroughs of Manhattan and the Bronx.

2. A high percentage of positive Schick reactions is found among the children in the entering classes in the kindergarten and 1 A grades. This varies in different schools from 60 to 85 per cent. The toxin-antitoxin injections could, therefore, be given to these young children without the preliminary Schick test.

3. The schools located in the less congested sections of the city and attended by children of the more well-to-do show, as a rule, from 100 to 200 per cent. more Schick positive reactors than those located in the crowded parts and attended by children of the poorer classes.

4. Repeated exposure to infection with the diphtheria bacillus is probably the most important factor in the development of "natural" immunity to this disease. Racial and hereditary family factors, although less important, also play a rôle.

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4. Dudley, S. F.: The Relation of Natural Diphtheria Antitoxin in the Blood of Man to Previous Infection with Diphtheria Bacilli, Brit. J. Exper. Path. **3**:204-210 (Aug.) 1922.

5. Herrman, Charles: Immunization Against Measles, Arch. Pediat. **39**: 607-610 (Sept.) 1922.

5. Girls show a somewhat larger percentage of positive Schick reactions than boys. They also show more negative-pseudo and positive-combined reactions. This holds true also for adults.

6. The high percentage of positive Schick reactors among young children of preschool age may, under certain conditions, render it advisable to simplify the procedure of immunization by omitting the preliminary Schick test. The children are simply injected with three doses of toxin-antitoxin. Under these circumstances, however, the children should not be pronounced immune to diphtheria until a supplementary Schick test, performed six months later, proves negative.

7. Diphtheria is the foremost fatal disease in children from 3 to 5 years of age, and ranks third among the fatal diseases of children from 1 to 3 years of age. Only diarrhea and pneumonia precede diphtheria in the mortality tables. The dangerous laryngeal form occurs in the young children. It is for these reasons that physicians should urge parents to take advantage of these newer methods to protect their young children against diphtheria. In fact, active immunization against diphtheria should become as much of a routine for all children between 6 months and 6 years as vaccination is against smallpox today.

THE WATER CONTENT OF INFANTS' BLOOD DURING PERIODS OF RAPID INCREASE IN WEIGHT *

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These studies were undertaken in order to determine whether or not there is an increase in the water content of the blood during the rapid gains in weight which not infrequently occur in healthy, artificially fed infants. Freund [1] has shown that these large weight increases are due to water retention. He studied the nitrogen and chlorid balance in a series of artificially fed infants and found that during the days of rapid gain the nitrogen retention was sufficient to account for only a small part of the increase in weight. That the major part was due to water retention was shown by the marked diminution in the elimination of chlorid and alkali salts.

In these studies the refractometric method was used to determine variations in the blood water. The technic employed was similar to that described in previous papers.[2] The serum proteins were calculated from the refractive index of serum according to the formula of Reiss.[3]

Five babies were used in this study. The babies chosen were healthy in the sense that they were not suffering from acute illnesses. Some of them were slightly underweight. In most instances, the weight gains were induced by increasing the carbohydrate content of the feeding. Edema never occurred. The weighings were made by a nurse, specially assigned to the care of the babies. Blood determinations were made at frequent intervals before and after the weight gains.

REPORT OF CASES

CASE 1 (Fig. 1).—S. W., a healthy boy, aged 3 months, was first observed, Nov. 3, 1920, when he weighed 4,100 gm. His feedings consisted of 450 c.c. of whole milk, 45 gm. of lactose and 360 c.c. of barley water.

November 8, the lactose in the feeding was increased to 105 gm. A sharp rise in weight followed, the baby gaining 450 gm. during the next seven days,

* Received for publication, April 16, 1923.

* From the Pediatric Division of the New York Nursery and Child's Hospital, and the Department of Pediatrics, Cornell University Medical College.

1. Freund, W.: Wasser und Salze in ihren Beziehungen zu den Körpergewichtsschwankungen der Saüglinge, Jahrb. f. Kinderh. **59**:421, 1904.

2. Bakwin, Harry: Dehydration in the New-Born, Am. J. Dis. Child. **24**:497 (Dec.) 1922.

3. Reiss, E.: Die refraktometrische Blutuntersuchungen und ihre Ergebnisse für die Physiologie und Pathologie des Menschen, Ergebn. d. inn. Med. u. Kinderh. **10**:531, 1913.

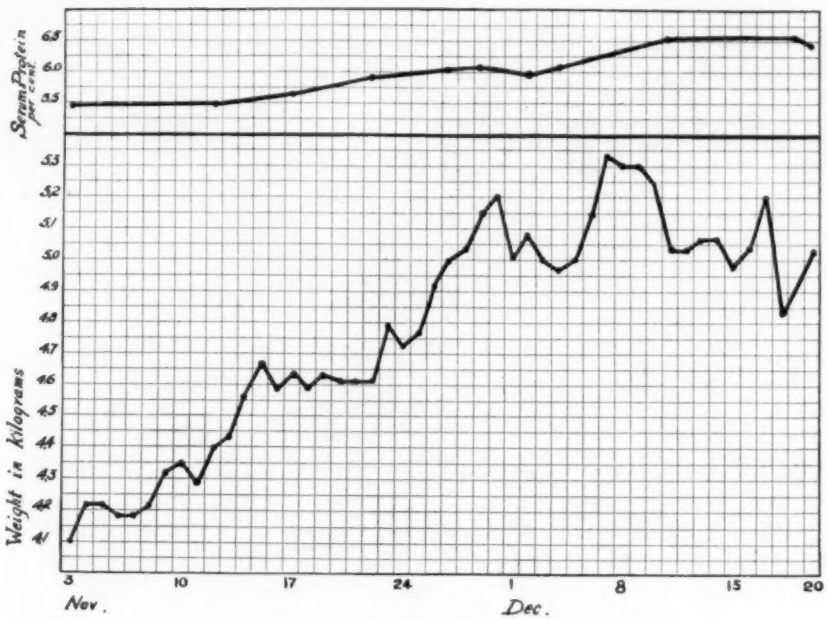

Chart 1.—Findings in Case 1.

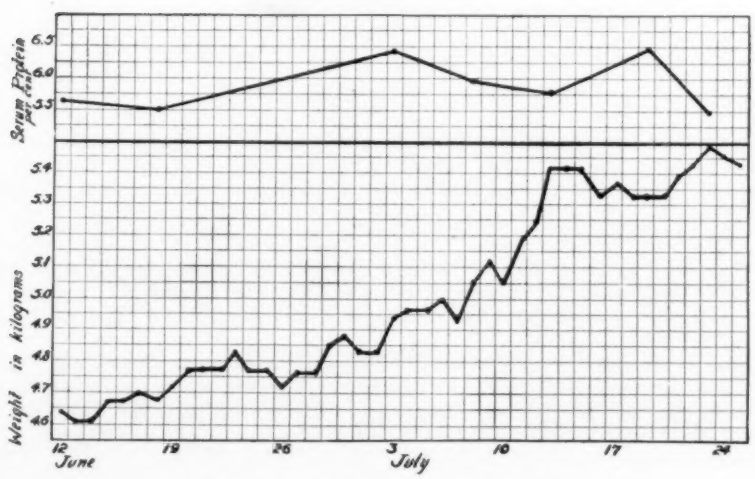

Chart 2.—Findings in Case 2.

an average daily gain of 65 gm. The weight remained stationary after this, and, November 19, the lactose was further increased to 150 gm., the amount of milk and water in the formula remaining unchanged. There was a slight gain in weight.

November 24, 180 gm. of maltose were substituted for the lactose in the feeding. This was followed by a sharp rise in weight so that the baby gained 470 gm. between the twenty-fourth and the thirtieth of November, an average daily gain of 79 gm. During this period the stools were frequent and slightly watery. December 1, the maltose was omitted from the feeding. The weight remained stationary, and the stools diminished in number and improved in consistency.

December 4, 180 gm. of maltose were again added to the feeding. Again a sharp rise in weight occurred, the baby gaining 360 gm. in three days. The maltose was again omitted from the feeding. The baby lost weight sharply. December 12, 30 gm. of maltose were added to the feeding, and, December 16

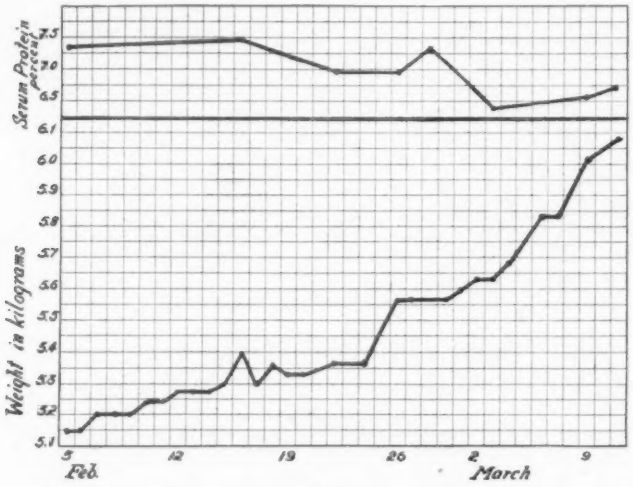

Chart 3.—Findings in Case 3.

this was increased to 45 gm. The second increase in the diet was followed by a sharp rise and then by a fall in weight.

Despite the marked variations in the weight, the serum proteins were little affected. They rose slowly and regularly from 5.45, November 3, to 6.55 per cent., December 21.

Case 2 (Fig. 2).—H. T., a healthy boy, aged 2½ months, was first observed, June 13, 1920, when he weighed 4,640 gm. He was receiving a feeding consisting of 450 c.c. of whole milk, 60 gm. of dextrimaltose and 450 c.c. of barley water, on which he gained slowly.

June 6, the dextrimaltose in the feeding was increased to 75 gm. and, June 9, to 90 gm. Following the second increase, there was a sharp rise in the weight, the baby gaining 370 gm. in three days. Coincident with the rapid gain in weight, there was a slight fall in the serum proteins from 5.9 per cent., July 8, when the weight was 5,050 gm. to 5.6, July 13, when the weight was 5,420 gm. The fall in serum protein concentration was only slightly greater than could be accounted for by errors inherent in the method for the collection and examination of the blood specimens.

Case 3 (Fig. 3).—A. G., a healthy boy, aged 3 months, was admitted, Jan. 24, 1920, when he weighed 5,000 gm. He had been under treatment for congenital

syphilis in the outpatient department since birth, but he showed no active lesions during his stay in the hospital. The blood Wassermann reaction was negative.

The infant was given a feeding consisting of 660 c.c. of whole milk, 60 gm. of lactose, and 240 c.c. of barley water, on which he gained slowly. Feb. 25, 1920, the lactose in the feeding was increased to 75 gm. Between February 24 and February 26, the baby gained 200 gm. During the marked increase in weight the serum protein precentage remained unchanged, indicating that the plasma water was not increased. On March 4, the lactose in the

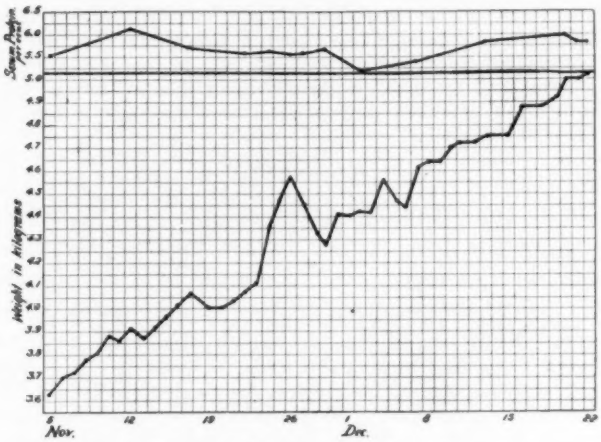

Chart 4.—Findings in Case 4.

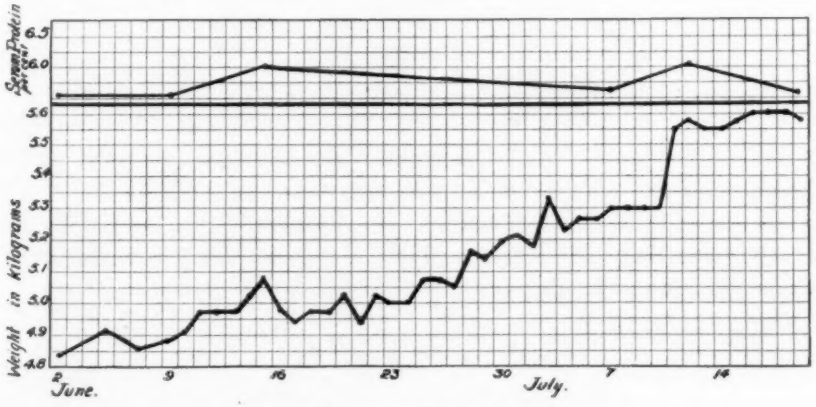

Chart 5.—Findings in Case 5.

feeding was further increased to 105 gm. During the following six days, the baby gained 380 gm., an average daily gain of 63 gm. Here again there was no fall in the serum protein concentration during or after the periods of rapid weight gain.

Case 4 (Fig. 4).—H. M., a healthy boy, aged 2 months, was first observed, Nov. 5, 1920, when he weighed 3,630 gm. He was receiving a feeding consisting of 360 c.c. of whole milk, 90 gm. of lactose and 360 c.c. of water, on which he gained well. November 20, the milk in the feeding was increased to 450 c.c.

November 23, 100 gm. of maltose were substituted for the 90 gm. of lactose in the feeding. During the next three days the baby gained 470 gm., and in the following three days he lost 300 gm. During the period of rapid gain and loss, the serum protein concentration remained unchanged.

CASE 5 (Fig. 5).—F. B., a healthy boy, aged 4 weeks, was admitted, April 9, 1920, when he weighed 3,970 gm.

June 2, when observations were started, he weighed 4,840 gm. and was receiving a feeding consisting of 420 c.c. of whole milk, 90 gm. of lactose and 390 c.c. of barley water, on which he gained slowly. June 19, the feeding was changed to 420 c.c. of whole lactic acid milk, 105 gm. of dextrimaltose and 390 c.c. of barley water. He did well on this until July 10, when, without change of feeding, he gained 250 gm. within twenty-four hours. During this twenty-four hour period he passed only 33 c.c. of urine.

Despite the marked gain in weight, no significant change in the serum protein concentration occurred, indicating that there was no increase in the water content of the plasma.

COMMENT

The effect of rapid gains in weight on the blood water was studied refractometrically in five cases. In no instance did a significant increase in the blood water occur. Since the increase in weight represents an increase in the water content of the organism, it seems clear that the increased amount of fluid is held in the tissues.

SUMMARY AND CONCLUSIONS

1. Freund has shown that marked variations in the weight curve of an artificially fed infant are due to changes in the water content of the organism.

2. Variations in the blood water were studied with the refractometric method in five babies before and after marked increases in weight.

3. Despite marked gains in weight (presumably due to an increase in the water content of the organism), no significant increase in the water content of the plasma occurred.

4. An increase in the amount of tissue fluid may occur in the healthy, artificially fed infant without a corresponding increase in the water content of the plasma.

BOOK REVIEWS

PREMATURE AND CONGENITALLY DISEASED INFANTS. By JULIUS H. HESS. Price, $5.50. Pp. 397, with 189 engravings. Philadelphia and New York: Lea & Febiger, 1922.

In this book the author presents the problem of the premature and congenitally diseased infant to the pediatrician, obstetrician and general practitioner. If these children are to be saved, preparations must be made beforehand, and every care used before, during and after delivery. While the mortality is, and always will be, high, still lives may be saved if precautions are taken. It is true that a number of these children may never progress normally; on the other hand, the author emphasizes the fact that some of them develop and may later be indistinguishable from those born at term.

The book consists of four parts. In the first, etiology, physiology and pathology are discussed. It contains many interesting and useful tables dealing with body weight and other measurements of the fetus. The author discusses heat regulation and points out that it is one of the least developed functions in the premature infant, and, therefore, special care must be taken to prevent hypothermia. He also gives a description of the various organs and illustrates, by means of pictures and tables, the changes that take place during development. Considerable space is given to discussion of the time of appearance of centers of ossification. He favors the roentgenographic method of determining the age of the fetus. This section is well illustrated by roentgenograms.

In Part II he enlarges on the nursing and feeding care. He dwells on the care of the mother, the choice of a wet nurse, diet for mothers, technic of nursing and of breast pressure. The author then emphasizes the chief points in the immediate care of the premature infant; giving plans of wards, with pictures of equipment and giving hospital records. The care of these children in the home, when they cannot be removed to the hospital, is also dealth with. Feeding is discussed at length, and a chapter is devoted to incubators.

General diseases observed in the premature infant are taken up fully by systems in Part III and are discussed, whenever possible, from the standpoint of etiology, morbid anatomy, symptoms, diagnosis, prognosis and treatment.

The outlook for the premature infant is dealt with in the last part.

The author covers his field thoroughly, and the work is intensely practical throughout.

SYPHILIS OF THE INNOCENT. By HARRY C. SOLOMON, B.S., M.D., and MAIDA HERMAN SOLOMON, A.B., B.S., Washington: United States Interdepartmental Social Hygiene Board, 1922.

This book is a well written, concise résumé of syphilis as a family disease. All unnecessary detail is eliminated, and the essential facts are presented in a brief but interesting manner. The five chapters are well arranged, following one another in logical sequence. Statistics are worked up in as interesting a manner as their purpose will permit. Syphilis with its protean manifestations is found in all the branches of medicine, and to the specialist, as well as to the general practitioner, the disease presents scientific, social and economic problems. The book as a study of the social effects of syphilis on the family and the community, with a proper evaluation of these effects, is of interest to physicians, as well as to social workers.

CORRECTIONS

Dr. David M. Siperstein requests that attention be directed to two errors that occurred in his articles which appeared in the February and March issues of the AMERICAN JOURNAL OF DISEASES OF CHILDREN. In the article in the February issue the subtitle of the caption of Table 9 should read "Blood Counts Following Hemorrhage," instead of "Blood Counts Following Injection." In the second article, which appeared in March, the erythrocyte counts in Table 2 should read: 4,160,000 and 4,280,000, instead of 5,160,000 and 5,280,000.

Dr. Dunn has called attention to an error in his article on "A Statistical Analysis of the Causes of Palpable Lymph Glands in the New-Born" in the April issue. On page 333, line 23, is a reference to Lippman which should read: "Thirteen of the babies had palpable inguinal glands. The normal leukocyte count established by Lippman was 16,600 at birth, 22,500 at 12 hours, 11,300 at 48 hours, and 9,500 by the fifth day of postnatal life."